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Pre-Remediation Implementation Work Plan

Boeing Realty Corporation
Former C-6 Facility
19503 South Normandie Avenue
Los Angeles, California

August 7, 2006

Prepared for:

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Project No. 27355-47930. T1C.PRE-REM

The information contained in the document titled "Pre-Remediation Implementation Work Plan" for site ""Former C-6 Facility, Los Angeles, California ", dated August 7, 2006 has received appropriate technical review and approval. The conclusions and recommendations presented represent professional judgments and are based upon findings from the investigations and sampling identified in the report and the interpretation of such data based on our experience and background. This acknowledgement is made in lieu of all warranties, either expressed or implied. The activities outlined in this report were performed under the supervision of a California Registered Professional Engineer.

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Re: 1 copy of the Final Pre-Remediation Implementation Work Plan for C-6 for your files

Job #: 27355-47930-T10A3.PMGT

Via: *Mail:* **Regular Mail** *Overnight:* *Courier:*

Enclosed please find: See below

For your information	XXX	**Approved**	
For your review		**Approved as noted**	
For your signature		**Returned to you for correction**	

Message:

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Signed

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Section 1
Introduction

1.1 Goals and Objectives

This work plan has been prepared for implementing pre-remediation activities at the Boeing Realty Corporation's (BRC) Former C-6 Facility (Site) in Los Angeles, California (Figure 1). The purpose of this implementation work plan is to perform certain pre-remediation activities that will assist in the implementation of bioremediation to reduce volatile organic compound (VOC) concentrations and mass within the Bellflower Aquitard beneath the Site.

1.2 Project Background

Two primary source areas have been identified at the Site (Former Buildings 2 and 1/36). The California Regional Water Quality Control Board – Los Angeles Region (LARWQCB) has previously approved *in situ* enhanced bioremediation (ISEB) Pilot Test Work Plans for the treatment of the Building 2 and 1/36 source-area groundwater VOC impacts in the Bellflower Aquitard. The LARWQCB has issued a General Waste Discharge Requirement (General WDR) permit for the Site. Infrastructure including injection (or amendment) wells and piping have been installed. Figure 2 shows the existing amendment wells and groundwater monitoring wells at the site. In general, the injection well networks were designed to treat VOC concentrations in excess of 5 milligrams per liter (mg/l) in groundwater beneath the source areas. The primary VOCs in the Building 2 and Building 1/36 areas vary slightly. The Building 2 primary VOCs include trichloroethene (TCE), 1,1-dichloroethene (1,1,-DCE), and chloroform. The Building 1/36 primary VOCs include TCE, 1,1-DCE, methyl ethyl ketone (MEK [2-butanone]), toluene, and 1,1,1-trichloroethane (1,1,1-TCA). Other VOCs are present in both areas but at lower concentrations. Remediation injections were initiated in the Building 2 area in 2004; however, technical difficulties prompted a review of the selected amendment and injection methods.

Based on CDM's evaluation of available data, the bioremediation/bioaugmentation strategy for the Site is expected to be ISEB with recirculation. This will involve pulsed injection of electron donor and bacteria into the groundwater that is being continuously recirculated. To further evaluate this approach and develop conceptual and final designs, CDM has prepared this pre-remediation implementation work plan. This work plan describes the field activities necessary to determine the condition of the existing wells and infrastructure and the usability of the same, verify aquifer properties, and determine the optimum electron donor(s) for ISEB with recirculation. This pre-remediation work plan does not address construction of additional remediation infrastructure. The scope of work in this document is based on the regulatory agency version of this work plan (CDM, February 14, 2006) which was approved by the LARWQCB on February 23, 2006.

1.3 Work Plan Organization

The rest of the work plan is organized as follows:

- Pre-Field Activities (Section 2): This section details the pre-field activities that must occur, including permitting, subcontracting, and health and safety planning.
- Evaluation of Existing Wells and Infrastructure (Section 3): This portion of the work plan discusses the evaluation of previous testing data and the determination of which wells are suitable for use, which are not suitable, and which require additional testing to determine their capabilities. This section also describes planned hydraulic injection testing, including key system components, test procedures, field notes and data logs, and data analysis.
- Aquifer Testing and Modeling (Section 4): This portion of the work plan includes procedures for drilling, groundwater and soil sample collection (for use in the treatability study), well installation, well development, and aquifer performance testing. A site plan showing the proposed locations of the wells is included. This section also summarizes groundwater modeling plans and procedures that will be used in analyzing the data from the aquifer test.
- Treatability Study and Electron Donor Evaluation (Section 5): The treatability study portion of the work plan includes procedures for study set-up, sampling, and analysis and presentation and interpretation of the results.
- Electron Donor Injection Test (Section 6): This section is reserved for future electron donor testing activities. Details on these activities will be provided following completion of the Treatability Study and Electron Donor Evaluation as described in Section 5.
- Data presentation and evaluation is discussed in Section 7.
- Project schedule information for the proposed activities is presented in Section 8.
- Spill prevention and contingency planning is discussed in Section 9.
- Housekeeping and residuals management is presented in Section 10.
- Section 11 contains information on project metrics.
- Section 12 presents project management details and information.
- Public communication is discussed in Section 13.

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Figure 1

Boeing Realty Corporation
Former C-6 Facility

Site Vicinity Map

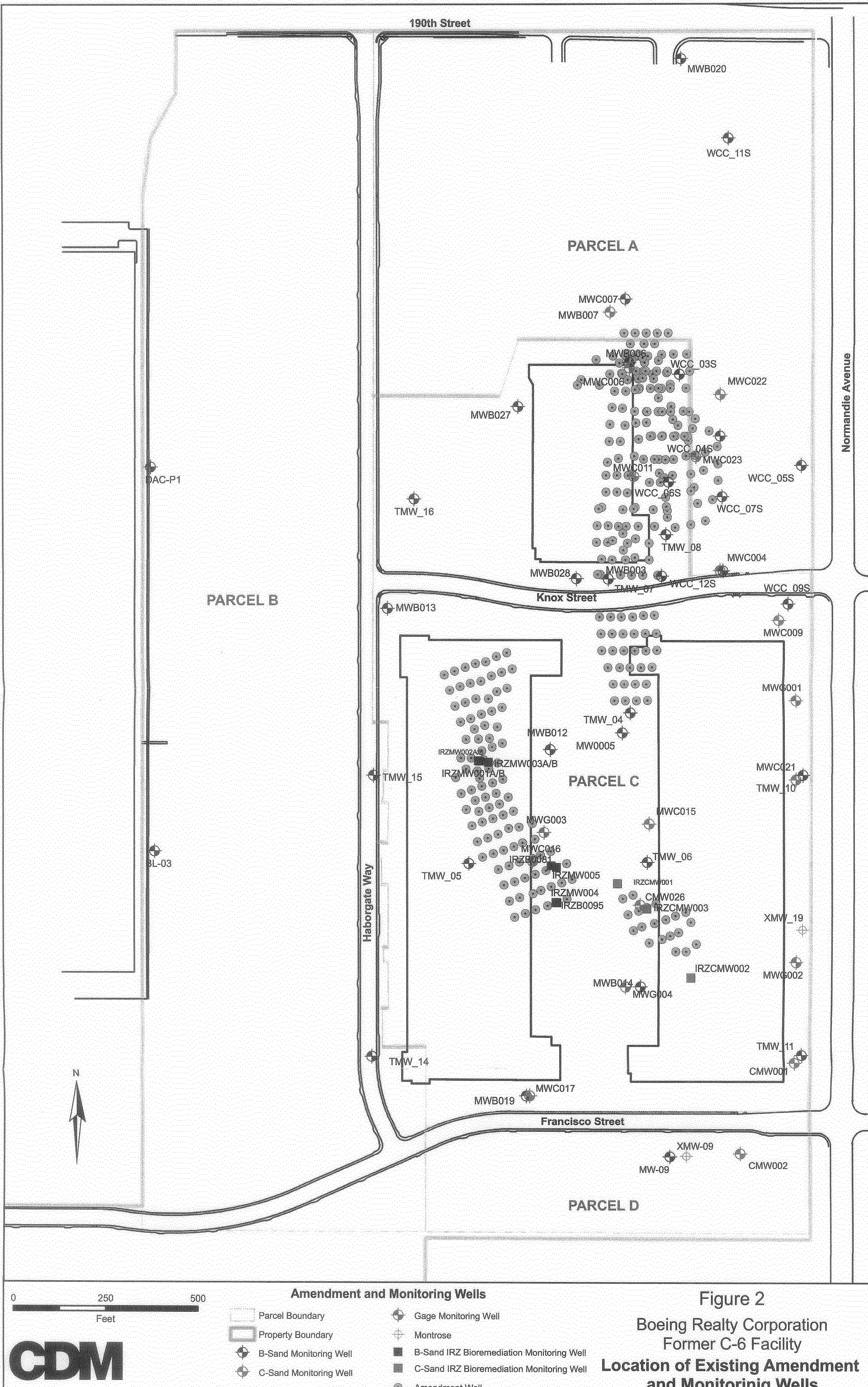

Figure 2
Boeing Realty Corporation
Former C-6 Facility
Location of Existing Amendment and Monitorinig Wells

Section 2

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Section Two

Section 2
Pre-Field Activities

2.1 Permits and Checklists

Field activities currently planned do not require additional permits from the LARWQCB, as hydraulic injection of potable water into the formation at the Site is not restricted under the general Waste Discharge Requirements (WDR) Order No. R4-2002-0030: Series 007. The RWQCB will be notified prior to conducting the field activities.

The Pre-Field checklist template is presented in Appendix A and will be completed at least one week prior to mobilization for field activities. Communication with BRC, property owners, and tenants will also occur to minimize the impact of pre-remediation activities on other activities at the site. Project staff will work with BRC, Haley &Aldrich, Inc., Sunrider (Former Building 2 area property owner), and other stakeholders to develop good working relationships while onsite. All project staff will work with oversight and management staff to help support good communication between BRC and stakeholders.

Temporary use of potable water from fire hydrants around the Site will require permission from Los Angeles Department of Water and Power (LADWP). Permission will be requested with sufficient lead time so as to not impact field scheduling. Details regarding temporary use of fire hydrants are available online at the following web address: http://www.ladwp.com/ladwp/cms/ladwp000735.jsp. Communication must occur with BRC, property owners, and tenants before permits are requested to ensure that the proper fire hydrants are selected for use. Fire hydrants located within the Sunrider property (located inside the block surrounded by Knox St, Harborgate Way, Francisco Street, and Normandie Avenue) cannot be used for testing.

For future electron donor injection testing (Section 6), injection of electron donors not in the general WDR will require a site-specific WDR permit.

2.2 Subcontracts

CDM will subcontract Tait Environmental Management, Inc. (TEM) and Jacob & Hefner Associates, Inc., (JHA) to conduct hydraulic testing portion of this program. CDM will provide TEM and JHA with clear instructions for implementation of the pre-remediation activities as described in this plan. CDM will also provide field forms, checklists, and standard operating procedures (all contained herein).

Due to time constraints, Boeing may decide to directly subcontract the drilling, well installation, and development activities to a qualified and licensed drilling subcontractor who has prior experience at the Site (such as WDC Exploration & Wells and Resonant Sonic Drilling) and who has been approved by BRC. The driller will use resonant sonic drilling methods. CDM will provide a licensed geologist to oversee and document field activities during drilling. TEM and JHA will provide field technician(s) required for field activities and will also survey the new well locations to match the Site coordinate system, as appropriate.

CDM will subcontract Severn Trent Labs, Los Angeles (STL) or DelMar Analytical Labs (DMA), both of which are BRC-approved analytical labs, for analytical needs.

2.3 Health and Safety

A site-specific health and safety plan (HSP) in accordance with Title 29 CFR, Section 1910.120 and 8 CCR 5192 has been prepared for implementing this work plan (CDM, 2006). The purpose of the HSP is to describe the controls and procedures that will be implemented to minimize any incidents, injury, and health risks during on-site activities. The HSP assigns responsibilities, establishes personnel protection standards and mandatory safety procedures, and specify appropriate measures and procedures taken for contingencies that may arise while operations are being conducted at the site. The HSP was prepared to cover all potential work, including remedy implementation and O&M at the former C-6 Facility. The HSP will be used by field staff while conducting field activities.

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Section Three

Section 3

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Section 3
Evaluation of Existing Amendment Wells

This section describes the evaluation of existing remediation infrastructure. This evaluation includes the review of available data and planned hydraulic injection testing. Additional testing related to electron donor injection is presented in Section 6.

3.1 Review of Available Data

3.1.1 Former Building 2 Area (Sunrider Property)

A detailed evaluation of the existing remediation infrastructure in the former Building 2 area was performed to determine its usability for further remediation at the Site. To this end, the existing documents and data generated by Arcadis G&M, Inc. (Arcadis), including the summary of pre-injection test data report (Arcadis, 2005), water injection test data report (Arcadis, 2004b), and an Excel spreadsheet containing a Arcadis water and electron donor injection data were reviewed.

The acceptability assessment of the 169 amendment wells in Former Building 2 area was based on flow rates, injection volumes, injection pressures, and field personnel observations during injection. These field observations included:

- observations of surface leakage;
- observations of siphoning during injection and after flow ceased;
- observed halts in flow during injection testing; and
- changes in performance after bleeding wellhead pressure.

After performing an initial evaluation and discussing the results, it was concluded by BRC and CDM that the future testing and operation should only be performed on injection wells that were capable of operating under vacuum conditions at the wellhead. If a well was capable of maintaining a siphon during operation, it could be used without any risk of surface leakage.

Therefore, prior testing data was reevaluated and the evaluation criteria were simplified. The only wells that were determined to be acceptable without any additional hydraulic testing were those wells that exhibited siphoning flow under all prior testing. If a well had shown prior evidence of leakage or was tagged out during prior testing, it was judged to be not usable for future remediation, with no need for additional testing. If a well failed to siphon during any previous testing round, it will require future hydraulic testing to determine if it can still operate under vacuum conditions. Also, if a well siphoned during all tests, but stopped accept flow during its final test, it will also require future hydraulic testing.

This evaluation of the 169 wells indicates that 17 wells are acceptable for use, 18 wells are not acceptable because of previous surface leakage, and 134 wells may be useable but may require additional testing. Table 1 at the end of this section shows a breakdown of all existing amendment wells. Figure 3 at the end of this section displays the location and testing status of all existing wells.

Of the 17 wells that were determined to be suitable for use without further testing, 11 of the wells were installed by hollow stem auger (HSA) techniques. All of these wells siphoned during each test. All demonstrated acceptable flow rates and pressure during multiple water and molasses injection tests. Based on review of Arcadis data, these wells did not appear to foul during injection tests.

Of the 18 wells that were determined to be unacceptable for use, all had been taken out of service by Arcadis during prior field work because of surface leakage, apparent fouling, or both.

The remaining 134 wells may be useable during future remediation activities but require additional testing. Testing conducted thus far has reflected one or more of the following negative conditions for each of these wells:

- Inconsistent or poor performance during water injection. Some wells exhibited acceptable performance during one injection, but then failed to siphon or had unacceptable performance in another test. Additional testing is necessary to confirm that these wells are useable and will siphon flow during future use.

- Relatively good performance during injection of water and/or injection of molasses, but not always with wellhead vacuum. Some wells exhibited strong flow rates with no apparent leakage and possibly even some siphoning after injection was complete. However, additional testing is needed to confirm that these wells can consistently achieve flow under vacuum conditions.

- Relatively good initial performance during the initial test(s) followed by poor performance during the molasses injection. Some wells appeared to become fouled during or after molasses injection, after which they ceased to siphon, ceased to accept flow, or both. Wells that received molasses injection should have been flushed with approximately 25 gallons of potable water (Arcadis, 2004b), but additional hydraulic testing is necessary to determine if the flush was effective in restoring function. Additional testing may also be necessary to determine if these wells can accept electron donor solutions under design conditions (see Section 6).

Additional testing proposed herein is therefore critical to determine the capabilities of these wells for the ISEB design.

3.1.2 Lot 8 (Former Building 1/36 Area)

Similar efforts were made to determine the usability of the 163 wells in the Lot 8 area; however the same amount of testing and injection testing data as Former Building 2 area was not available for these wells. Some post-installation water injection tests were conducted on 19 of these wells by Haley & Aldrich in 2004 and 2005.

However, these tests did not produce any data to confirm that the Lot 8 wells can support acceptable flow under vacuum conditions. Therefore, any wells which will be used must be hydraulically tested.

Previous electron donor injection was also performed on four of the wells in this area (Arcadis, 2005). All of the wells accepted at least 2 gpm of flow. One of the wells, AW0077B, did not maintain the same level of siphoning after shutdown, and appeared to foul near the end of the injection. Arcadis concluded that this reduction in flow may have been attributable to gas build up in the well, lower hydraulic conductivity in the nearby soil, or yeast formation in the donor. Further electron donor injection testing of at least some of the wells may be also necessary to evaluate if these wells can accept electron donor solutions under design conditions (see Section 6).

3.2 Hydraulic Testing

Hydraulic testing will consist of delivering potable water into the well while monitoring the water flow rate, the pressure in the conveyance piping, and visual indications of surface leakage within the building. These parameters will be used to determine the capabilities of the well within the design of the remediation system.

3.2.1 Key System Components

Evaluation will be conducted using potable water. Water will be obtained from nearby fire hydrants using a meter and a fire hose and will be filtered. Fire hydrant water will be tested for VOCs, pH, total dissolved solids (TDS), specific conductivity, total suspended solids (TSS), turbidity, hardness, alkalinity, chlorine, chloride, nitrate, and sulfate. A back-flow preventer will be installed on the line as well. Communication with BRC, property owners, and tenants will occur to minimize the impact of testing on other activities at the site. Based on communications with BRC, fire hydrants located within the Sunrider property (located on the block surrounded by Knox St, Harborgate Way, Francisco Street, and Normandie Avenue) will NOT be used for testing. There are three fire hydrants located on the west side of Harborgate Way (across the street), spaced evenly along the block, which will be used for testing of Vaults 1-3. Fire hydrants for testing Vaults 4 and 5 will be located following discussion with BRC, property owners, and tenants. Field staff must verify that fire hydrants on that block are usable before permits are requested, and this will require communication with Sunrider to determine which hydrants are associated with their infrastructure and which fall into the public right-of-way. In any event, where hoses cross live traffic areas, hose guards will be used.

Water will be piped directly to the BRC mobile manifold system for control and distribution. The manifold header is currently constructed of 1-inch pipe with cam locks on the inlet and discharge to the system. However, the manifold header will be rebuilt with 3 inch piping to allow for more flow before testing begins. Several testing 1-in "limbs" are connected to the header of the manifold, and these will be used to control flow to each well.

Each manifold limb consists of a quick disconnect fitting, a gate valve to control flow, a turbine-style flow meter and totalizer, a compound pressure/vacuum gauge, and a check valve. Water will be conveyed to the vault or well head using 1-inch flexible hose with cam and groove (cam-lock) fittings. Field staff will verify all flowmeters prior to use and calibrate or replace flowmeters as needed. If any new flowmeters are needed, field staff will procure flowmeters that are well suited for the application and will measure flow rates without significant error. Flow rates may be compared to the meter on the fire hydrant as well.

Dole flow control valves (see cut sheets in Appendix B) will be added onto the manifold between the quick disconnect fitting and the flow meter. These valves contain a flexible internal orifice that contracts and expands depending on the pressure drop across the valve. If the pressure in the line increases, the orifice shifts and restricts the flow rate. This keeps the flow rate relatively constant over a wide range of pressures. Flow valves rated at 1.0 gallons per minute (gpm), 2.0 gpm, 4.0 gpm, and 8.0 gpm will be used.

The valves will be connected to quick disconnect fittings so they can be swapped in and out of the manifold rapidly during hydraulic testing. This will alleviate the need to continually rebalance the flow through the manifold and will simplify testing.

Table 3 at the end of this section provides the equipment inventory and needs for this phase of the project. Site staff will maintain a spare parts inventory in case of part failure or need.

3.2.2 Field Work Preparations and Staging

Before any testing is initiated, the pre-field activities detailed in Section 2 will be completed. Project staff will work to identify and procure long-lead time equipment, if any. Project staff will also communicate with BRC, property owners, and tenants to determine acceptable locations of field equipment, water hoses and hose guards, and other site disturbances. Project staff will communicate with BRC, property owners, and tenants to determine an acceptable schedule for testing so that personnel can access vaults and can monitor inside the buildings for surface seal leakage without being disruptive of Site activities. Finally, project staff will arrange for the delivery of all field equipment to the site and other logistics, such as arranging for fire hydrant use.

Prior to any testing, field staff will use as-built drawings provided by BRC to verify all well tags are correct and legible. Field staff will also verify that wells that have been tagged out because of previous leakage during testing are easily distinguishable from those wells that have not been tagged out.

3.2.3 Test Procedures

Field staff will verify the hydraulic capabilities of the amendment wells with step-testing. Field staff will first inject water to fill the conveyance piping, fill the well casing, saturate the filter pack, and promote faster attainment of steady state conditions. Water will be injected for 1 hour or until the total volume exceeds 200 gallons, whichever occurs first. The largest amount of water required to fill the conveyance piping, the well casing, and the void space in the sand filter pack is not anticipated to exceed 40 gallons. No Dole valve will be in place during the initial filling, but field staff will meter flow using the gate valve on each limb and will monitor pressure using the compound pressure/vacuum gauge in the line at the manifold. Based on previous testing of these wells, the maximum allowable pressure of 1 psig pressure over the static water column head at the well screen will be used. Field staff will use the information provided in Table 2 to determine maximum allowable pressure. Under low flow conditions, line losses will not be large, but as flow increases, pressure losses and allowable maximum manifold pressures will increase. If field staff observes that pressure at the wellhead of 1 psig, indicating that the well is no longer siphoning flow, then the test will be ceased. Testing will only be performed so long as the well is under negative pressure (e.g. siphoning). Additional details on testing procedures are presented in Appendix B.

Once in the initial injection has occurred, field staff will then begin delivering water at a low flow rate (e.g. with a 1.0 gpm Dole valve), while monitoring pressure. After a short duration and stabilization, field staff will swap the Dole valve with the next larger one (2 gpm) and inject more water. This process will be repeated as long as the flow into the well is within 20 percent of the rated flow rate of the Dole valve being used. If the flow into well drops more than 20 percent below the rated flow rate for the Dole valve, then field staff will stop swapping Dole valves, and will attempt to maintain that flow for approximately 30 minutes. Once each well has been tested, field staff will move on to the next well. During all testing, field staff will be performing visual monitoring for signs of surface leakage. If surface leakage is observed, injection testing will be ceased and contingency plans will be implemented as necessary.

Due to the large quantity of wells, the small size of the vaults, and the number of testing manifolds available, approximately 12 wells are planned to be tested concurrently, but the actual number of wells will be field adjusted as appropriate to account for well-specific conditions. Although well spacing should be sufficiently large to minimize hydraulic interference between adjacent wells during testing, field staff will not simultaneously test one well pair (i.e. IRZB34A and IRZB34B) and will work to minimize testing of adjacent wells. The number of wells shall not exceed the field staff's ability to manage the testing, monitor the testing parameters, and respond in case of an contingency situation, such as surface leakage.

Complete testing procedures are presented in Appendix B. Housekeeping and Site management information is presented in Section 10.

3.2.4 Field Notes and Data Logs

Field notes will completed on a daily basis, and will include time of day, activities performed, personnel present, site conditions, materials used during tests, highlights and difficulties encountered during the day.

The data log will contain all the injection testing data collected, including time, manifold pressure, maximum allowable manifold pressure, flow rate, flow total, adjustments made to manifold valves, and field observations. The data log will be completed during testing.

Template field forms are presented in Appendix C.

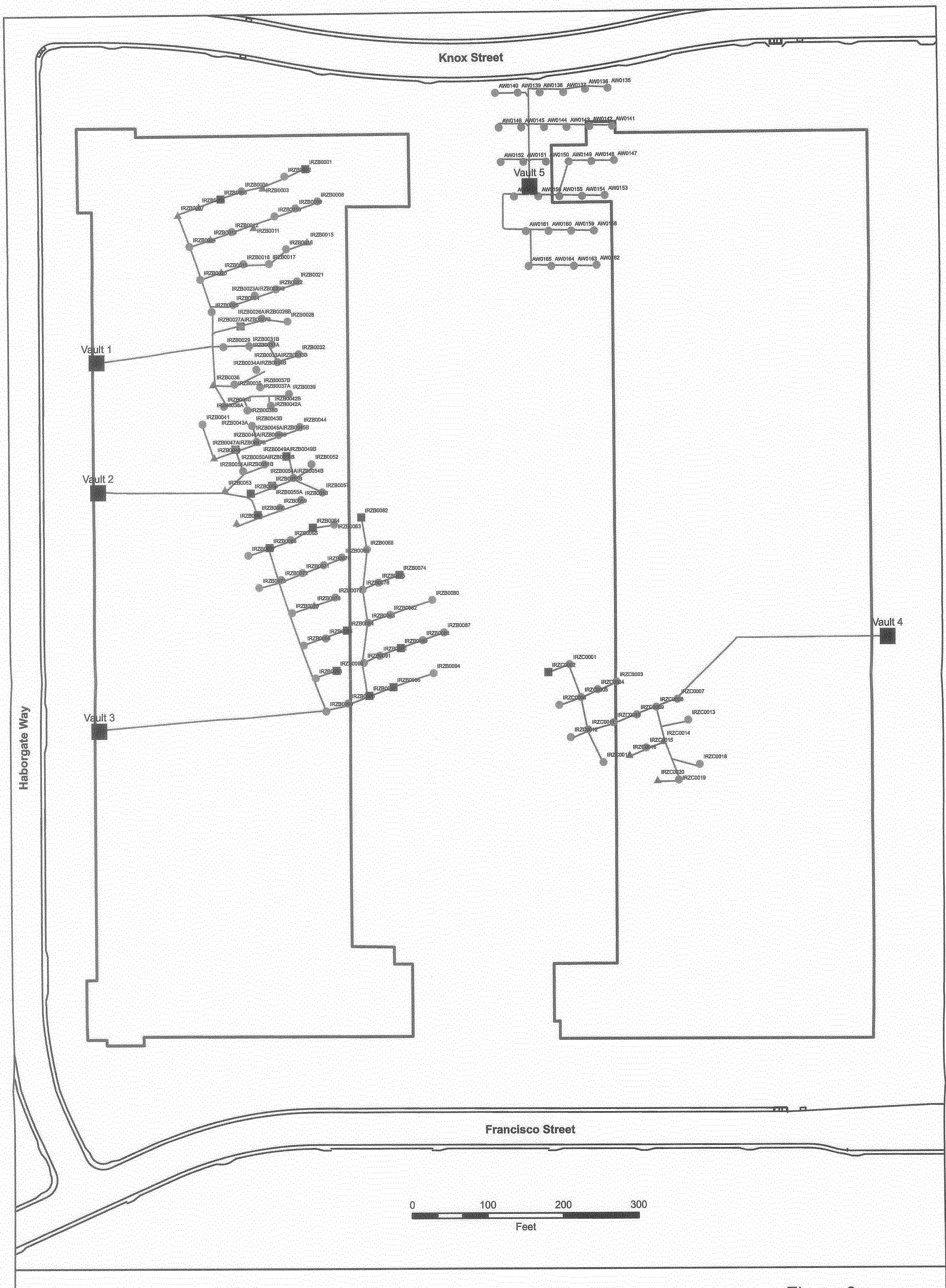
3.2.5 Data Analysis and Reporting

Following the implementation of the hydraulic testing, field sheets and notes will be collected and entered into a spreadsheet for analysis. Testing data will be used by project staff to evaluate the hydraulic performance each of the tested wells. Project staff will assess if the capabilities of these wells merit additional investment during installation, operation, and maintenance of the remediation system.

No baseline preliminary acceptance criteria have been set for the wells in question, as the performance of each well during hydraulic injection only contributes some of the information required to determine its usability. Whether a well is selected for use during remediation design will depend on design flow rates and pressures, aquifer testing and modeling, the proximity of other usable wells, and any results from electron donor injection (see Section 6). Design flow rates and injection pressures will depend on the results of aquifer testing and modeling. Aquifer modeling will predict which areas need more coverage by amendment wells, and which areas have sufficient coverage to achieve remediation goals. For example, if prior testing data indicate many or all of the amendment wells near a well in question are not usable, that well in question may be selected for use despite less than ideal testing performance. Conversely, in areas with good coverage of usable wells, it will not be necessary to use wells with poor testing performance. Future electron donor injection testing may also be used to determine if wells will be used during remediation as well.

Following completion of the field testing and data analysis, a draft technical memorandum will be prepared for BRC's review. The data from the "paper" evaluation and field testing will be presented with the goal of identifying which existing amendment wells are useable under the proposed remediation plan. The memorandum will also document the handling of produced waters from the testing program. Presentation of results from any additional electron donor injection testing is discussed in Section 6.

The memorandum will be finalized upon receipt and consideration of comments from BRC.



Proposed Hydraulic Test Wells

- Bioremediation Pipeline
- Vaults
- Requires Hydraulic Testing
- Usable
- Not Usable

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Figure 3
Boeing Realty Corporation
Former C-6 Facilty
Former Building 2 Area
Proposed Hydraulic Test Well Locations

NOTES:
1. Hydraulic testing will not take place until the Focused Feaibility Study is completed and a preferred remedial alternative is selected.
At that time, the scope of testing and schedule will be determined. Only wells that will be used within the selected remedial alternative will be tested.
2. Well and piping locations are approximate.

Proposed Hydraulic Test Wells

Bioremediation Pipeline

Vaults

Requires Hydraulic Testing

Usable

Not Usable

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Figure 4
Boeing Realty Corporation
Former C-6 Facilty
Lot 8 Area
Proposed Hydraulic Test Well Locations

Table 1
Existing Amendment Well Summary

Location	Number of Amendment Wells			
	Acceptable for use	Not acceptable for use	Requires additional hydraulic testing [a]	Total [d]
Building 2 - Vault 1	8	3	40	51
Building 2 -Vault 2	5	5	19	29
Building 2 -Vault 3	1	9	28	38
Building 2 -Vault 4	3	1	16	20
Building 2 -Vault 5	0	0	31	31
Lot 8 – Vault 1	0	0	56	56
Lot 8 – Vault 2	0	0	54	54
Lot 8 – Vault 3	0	0	53	53
Total	17	18	297	332

Notes:

a All the wells listed in this column require additional hydraulic testing to confirm their capabilities. Some of these wells may also merit additional electron donor testing, depending on the results of the hydraulic testing and past electron donor injection testing.

b These wells are generally acceptable hydraulically. They have not tested with an electron donor injection. Additional electron donor testing of at least some of these wells is necessary to confirm these wells can accept electron donor solutions under design conditions.

c Many of these wells was tested hydraulically during the FIT (flow injection testing) program, but it is understood that none were tested to determine if they could maintain a vacuum at the wellhead (i.e. siphoning conditions). Electron donor testing of at least some of these wells may also be necessary to confirm these wells can accept electron donor solutions under design conditions (see Section 6).

d Totals for Lot 8 are based on Lot 8 as-built drawings prepared by Haley & Aldrich (May 2006).

Table 2
Hydraulic Testing Schedule

Injection Well	Vault	Method of Installation	Maximum Manifold Pressure at 0.5 gpm (psi)	Maximum Manifold Pressure at 1.0 gpm (psi)	Maximum Manifold Pressure at 2.0 gpm (psi)	Maximum Manifold Pressure at 4.0 gpm (psi)	Maximum Manifold Pressure at 8.0 gpm (psi)
Former Building 2 Area							
IRZB02	1	DPT	1.3	2.1	5.2	14.8	50.7
IRZB04	1	DPT	1.3	2.0	4.7	13.0	44.3
IRZB08	1	DPT	1.3	2.1	5.1	14.5	49.6
IRZB09	1	DPT	1.3	2.0	4.9	13.6	46.4
IRZB10	1	DPT	1.3	2.0	4.6	12.7	43.3
IRZB12	1	HSA	1.2	1.8	4.2	11.0	36.9
IRZB14	1	HSA	1.2	1.7	3.7	9.2	30.6
IRZB16	1	DPT	1.2	1.9	4.3	11.5	39.0
IRZB17	1	HSA	1.2	1.8	4.1	10.7	35.9
IRZB18	1	HSA	1.2	1.7	3.8	9.8	32.7
IRZB20	1	DPT	1.2	1.6	3.4	8.0	26.4
IRZB21	1	HSA	1.2	1.8	4.0	10.4	34.8
IRZB22	1	HSA	1.2	1.7	3.8	9.5	31.6
IRZB23 A	1	DPT	1.2	1.6	3.5	8.6	28.5
IRZB23 B	1	DPT	1.2	1.6	3.5	8.6	28.5
IRZB24	1	HSA	1.1	1.6	3.3	7.7	25.3
IRZB25	1	HSA	1.1	1.5	3.1	6.9	22.1
IRZB26 A	1	DPT	1.1	1.6	3.3	7.9	25.8
IRZB26 B	1	DPT	1.1	1.6	3.3	7.9	25.8
IRZB0027B	1	DPT	1.1	1.5	3.1	7.0	22.7
IRZB0028	1	HSA	1.2	1.6	3.5	8.6	28.5

Injection Well	Vault	Method of Installation	Maximum Manifold Pressure at 0.5 gpm (psi)	Maximum Manifold Pressure at 1.0 gpm (psi)	Maximum Manifold Pressure at 2.0 gpm (psi)	Maximum Manifold Pressure at 4.0 gpm (psi)	Maximum Manifold Pressure at 8.0 gpm (psi)
IRZB0029	1	HSA	1.1	1.4	2.8	6.0	19.0
IRZB0030A	1	DPT	1.1	1.6	3.3	7.7	25.3
IRZB0030B	1	DPT	1.1	1.6	3.3	7.7	25.3
IRZB0031A	1	DPT	1.1	1.5	3.1	6.9	22.1
IRZB0031B	1	DPT	1.1	1.5	3.1	6.9	22.1
IRZB0032	1	HSA	1.2	1.8	4.0	10.4	34.8
IRZB0033A	1	DPT	1.2	1.7	3.8	9.5	31.6
IRZB0033B	1	DPT	1.2	1.7	3.8	9.5	31.6
IRZB0034A	1	DPT	1.2	1.6	3.5	8.6	28.5
IRZB0034B	1	DPT	1.2	1.6	3.5	8.6	28.5
IRZB0035	1	HSA	1.1	1.6	3.3	7.7	25.3
IRZB0037A	1	HSA	1.2	1.7	3.8	9.5	31.6
IRZB0037B	1	HSA	1.2	1.7	3.8	9.5	31.6
IRZB0038A	1	DPT	1.2	1.6	3.5	8.6	28.5
IRZB0038B	1	DPT	1.2	1.6	3.5	8.6	28.5
IRZB0039	1	DPT	1.2	1.8	4.0	10.4	34.8
IRZB0040	1	DPT	1.1	1.6	3.3	7.7	25.3
IRZB0042A	1	DPT	1.2	1.8	4.0	10.4	34.8
IRZB0042B	1	DPT	1.2	1.8	4.0	10.4	34.8
IRZB41	2	HSA	1.2	1.7	3.8	9.8	32.7
IRZB43 A	2	DPT	1.2	1.7	3.8	9.5	31.6
IRZB43 B	2	DPT	1.2	1.7	3.8	9.5	31.6
IRZB44	2	DPT	1.2	1.8	4.0	10.4	34.8
IRZB45 A	2	DPT	1.2	1.7	3.8	9.5	31.6
IRZB45 B	2	DPT	1.2	1.7	3.8	9.5	31.6
IRZB46 A	2	DPT	1.2	1.6	3.5	8.6	28.5

Injection Well	Vault	Method of Installation	Maximum Manifold Pressure at 0.5 gpm (psi)	Maximum Manifold Pressure at 1.0 gpm (psi)	Maximum Manifold Pressure at 2.0 gpm (psi)	Maximum Manifold Pressure at 4.0 gpm (psi)	Maximum Manifold Pressure at 8.0 gpm (psi)
IRZB47 B	2	DPT	1.1	1.6	3.3	7.7	25.3
IRZB50 A	2	DPT	1.1	1.6	3.3	7.7	25.3
IRZB50 B	2	DPT	1.1	1.6	3.3	7.7	25.3
IRZB51 A	2	DPT	1.1	1.5	3.1	6.9	22.1
IRZB51 B	2	DPT	1.1	1.5	3.1	6.9	22.1
IRZB52	2	DPT	1.2	1.7	3.8	9.5	31.6
IRZB54 A	2	DPT	1.2	1.6	3.5	8.6	28.5
IRZB54 B	2	DPT	1.2	1.6	3.5	8.6	28.5
IRZB55 B	2	DPT	1.1	1.6	3.3	7.7	25.3
IRZB57	2	DPT	1.2	1.7	3.8	9.8	32.7
IRZB58	2	DPT	1.2	1.7	3.8	9.5	31.6
IRZB59	2	DPT	1.2	1.6	3.5	8.6	28.5
IRZB63	3	DPT	1.4	2.4	6.2	18.6	64.4
IRZB65	3	DPT	1.3	2.3	5.7	16.8	58.0
IRZB67	3	DPT	1.3	2.3	5.7	16.8	58.0
IRZB68	3	DPT	1.3	2.3	5.7	16.8	58.0
IRZB69	3	DPT	1.3	2.3	5.8	17.1	59.1
IRZB70	3	DPT	1.3	2.3	5.6	16.2	55.9
IRZB71	3	DPT	1.3	2.2	5.3	15.4	52.8
IRZB72	3	DPT	1.3	2.1	5.1	14.5	49.6
IRZB73	3	DPT	1.3	2.2	5.3	15.4	52.8
IRZB75	3	DPT	1.3	2.3	5.6	16.2	55.9
IRZB76	3	DPT	1.3	2.2	5.3	15.4	52.8
IRZB77	3	DPT	1.3	2.2	5.2	15.1	51.7
IRZB79	3	HSA	1.3	2.0	4.8	13.3	45.4
IRZB80	3	DPT	1.3	2.3	5.7	16.8	58.0

Injection Well	Vault	Method of Installation	Maximum Manifold Pressure at 0.5 gpm (psi)	Maximum Manifold Pressure at 1.0 gpm (psi)	Maximum Manifold Pressure at 2.0 gpm (psi)	Maximum Manifold Pressure at 4.0 gpm (psi)	Maximum Manifold Pressure at 8.0 gpm (psi)
IRZB81	3	DPT	1.3	2.2	5.5	15.9	54.9
IRZB82	3	DPT	1.3	2.2	5.2	15.1	51.7
IRZB83	3	DPT	1.3	2.1	5.0	14.2	48.5
IRZB85	3	DPT	1.3	2.0	4.7	13.0	44.3
IRZB86	3	HSA	1.2	1.9	4.5	12.1	41.1
IRZB87	3	DPT	1.3	2.3	5.6	16.2	55.9
IRZB88	3	DPT	1.3	2.2	5.3	15.4	52.8
IRZB90	3	DPT	1.3	2.0	4.9	13.6	46.4
IRZB91	3	DPT	1.3	2.0	4.6	12.7	43.3
IRZB93	3	DPT	1.2	1.8	4.2	11.0	36.9
IRZB94	3	DPT	1.3	2.1	5.0	14.2	48.5
IRZB95	3	DPT	1.3	2.0	4.8	13.3	45.4
IRZB98	3	DPT	1.2	1.8	4.1	10.7	35.9
IRZB99	3	HSA	1.2	1.7	3.8	9.8	32.7
IRZC01	4	HSA	1.3	2.2	5.2	15.1	51.7
IRZC03	4	HSA	1.3	2.2	5.5	15.9	54.9
IRZC04	4	HSA	1.3	2.2	5.2	15.1	51.7
IRZC05	4	HSA	1.3	2.1	5.0	14.2	48.5
IRZC06	4	HSA	1.3	2.2	5.2	15.1	51.7
IRZC07	4	HSA	1.2	1.7	3.8	9.8	32.7
IRZC08	4	HSA	1.2	1.8	4.1	10.7	35.9
IRZC09	4	HSA	1.2	1.9	4.3	11.5	39.0
IRZC10	4	HSA	1.2	1.9	4.5	12.4	42.2
IRZC11	4	HSA	1.3	2.0	4.8	13.3	45.4
IRZC12	4	HSA	1.3	2.1	5.0	14.2	48.5
IRZC13	4	HSA	1.2	1.8	4.1	10.7	35.9

Injection Well	Vault	Method of Installation	Maximum Manifold Pressure at 0.5 gpm (psi)	Maximum Manifold Pressure at 1.0 gpm (psi)	Maximum Manifold Pressure at 2.0 gpm (psi)	Maximum Manifold Pressure at 4.0 gpm (psi)	Maximum Manifold Pressure at 8.0 gpm (psi)
IRZC15	4	HSA	1.2	1.9	4.5	12.4	42.2
IRZC17	4	HSA	1.3	2.1	5.0	14.2	48.5
IRZC18	4	HSA	1.3	2.1	5.1	14.5	49.6
IRZC19	4	HSA	1.3	2.0	4.9	13.6	46.4
AW0135	5	DPT	1.2	1.6	3.4	8.0	26.4
AW0136	5	DPT	1.2	1.6	3.4	8.0	26.4
AW0137	5	DPT	1.1	1.4	2.9	6.3	20.0
AW0138	5	DPT	1.1	1.3	2.6	5.1	15.8
AW0139	5	DPT	1.1	1.5	3.0	6.6	21.1
AW0140	5	DPT	1.1	1.4	2.9	6.3	20.0
AW0141	5	DPT	1.2	1.6	3.5	8.6	28.5
AW0142	5	DPT	1.1	1.4	2.8	6.0	19.0
AW0143	5	DPT	1.1	1.4	2.9	6.3	20.0
AW0144	5	DPT	1.1	1.2	2.3	4.1	11.6
AW0145	5	DPT	1.1	1.2	2.2	3.8	10.5
AW0146	5	DPT	1.1	1.3	2.5	4.9	14.7
AW0147	5	DPT	1.1	1.4	2.8	6.0	19.0
AW0148	5	DPT	1.1	1.3	2.6	5.1	15.8
AW0149	5	DPT	1.1	1.2	2.3	4.1	11.6
AW0150	5	DPT	1.0	1.2	2.0	3.3	8.4
AW0151	5	DPT	1.0	1.1	1.9	2.8	6.3
AW0152	5	DPT	1.1	1.2	2.1	3.6	9.5
AW0153	5	DPT	1.1	1.3	2.4	4.6	13.7
AW0154	5	DPT	1.1	1.2	2.1	3.6	9.5
AW0155	5	DPT	1.0	1.1	1.9	2.8	6.3
AW0156	5	DPT	1.0	1.1	1.7	2.3	4.2

Injection Well	Vault	Method of Installation	Maximum Manifold Pressure at 0.5 gpm (psi)	Maximum Manifold Pressure at 1.0 gpm (psi)	Maximum Manifold Pressure at 2.0 gpm (psi)	Maximum Manifold Pressure at 4.0 gpm (psi)	Maximum Manifold Pressure at 8.0 gpm (psi)
AW0157	5	DPT	1.0	1.1	1.7	2.3	4.2
AW0158	5	DPT	1.1	1.6	3.3	7.7	25.3
AW0159	5	DPT	1.1	1.5	3.0	6.6	21.1
AW0160	5	DPT	1.1	1.4	2.8	6.0	19.0
AW0161	5	DPT	1.1	1.3	2.5	4.9	14.7
AW0162	5	DPT	1.2	1.7	3.7	9.2	30.6
AW0163	5	DPT	1.2	1.6	3.5	8.3	27.4
AW0164	5	DPT	1.1	1.5	3.2	7.4	24.2
AW0165	5	DPT	1.1	1.5	3.0	6.6	21.1
Lot 8 Area							
AW0001UB	Lot 8 - 1	HSA	1.0	1.1	1.8	2.6	5.4
AW0002UB	Lot 8 - 1	HSA	1.0	1.1	1.8	2.5	4.9
AW0003UB	Lot 8 - 1	HSA	1.0	1.1	1.7	2.2	3.7
AW0004UB	Lot 8 - 1	HSA	1.0	1.1	1.7	2.0	3.3
AW0005UB	Lot 8 - 1	HSA	1.0	1.0	1.6	1.8	2.6
AW0006B	Lot 8 - 1	HSA	1.0	1.1	1.7	2.2	3.7
AW0007B	Lot 8 - 1	HSA	1.0	1.0	1.6	2.0	3.1
AW0008B	Lot 8 - 1	HSA	1.0	1.0	1.6	1.8	2.4
AW0009UB	Lot 8 - 1	HSA	1.0	1.2	2.1	3.4	8.5
AW0010UB	Lot 8 - 1	HSA	1.0	1.1	1.8	2.6	5.4
AW0011B	Lot 8 - 1	HSA	1.0	1.1	1.7	2.2	3.7
AW0011C	Lot 8 - 1	HSA	1.0	1.1	1.7	2.2	3.7
AW0012B	Lot 8 - 1	HSA	1.0	1.1	1.8	2.4	4.4
AW0013B	Lot 8 - 1	HSA	1.0	1.0	1.6	2.0	3.1
AW0013C	Lot 8 - 1	HSA	1.0	1.1	1.7	2.0	3.3
AW0014B	Lot 8 - 1	HSA	1.0	1.0	1.6	1.7	2.2

Injection Well	Vault	Method of Installation	Maximum Manifold Pressure at 0.5 gpm (psi)	Maximum Manifold Pressure at 1.0 gpm (psi)	Maximum Manifold Pressure at 2.0 gpm (psi)	Maximum Manifold Pressure at 4.0 gpm (psi)	Maximum Manifold Pressure at 8.0 gpm (psi)
AW0014C	Lot 8 - 1	HSA	1.0	1.1	1.7	2.0	3.3
AW0015B	Lot 8 - 1	HSA	1.0	1.0	1.6	1.8	2.4
AW0016B	Lot 8 - 1	HSA	1.0	1.1	1.8	2.4	4.6
AW0017UB	Lot 8 - 1	HSA	1.0	1.1	1.9	3.0	6.7
AW0018B	Lot 8 - 1	HSA	1.0	1.0	1.6	2.0	3.1
AW0018C	Lot 8 - 1	HSA	1.0	1.0	1.6	2.0	3.1
AW0019C	Lot 8 - 1	HSA	1.0	1.0	1.6	1.8	2.4
AW0020UB	Lot 8 - 1	HSA	1.0	1.2	2.0	3.2	7.8
AW0021B	Lot 8 - 1	HSA	1.0	1.1	1.7	2.2	3.9
AW0021C	Lot 8 - 1	HSA	1.0	1.1	1.7	2.1	3.5
AW0022B	Lot 8 - 1	HSA	1.0	1.1	1.7	2.2	3.9
AW0022C	Lot 8 - 1	HSA	1.0	1.1	1.7	2.2	3.9
AW0023B	Lot 8 - 1	HSA	1.0	1.1	1.8	2.6	5.4
AW0023C	Lot 8 - 1	HSA	1.0	1.1	1.8	2.6	5.4
AW0024UB	Lot 8 - 2	HSA	1.0	1.1	1.8	2.5	4.9
AW0025UB	Lot 8 - 1	HSA	1.0	1.1	1.8	2.4	4.4
AW0025C	Lot 8 - 1	HSA	1.0	1.1	1.8	2.4	4.6
AW0026B	Lot 8 - 1	HSA	1.0	1.1	1.8	2.4	4.6
AW0026C	Lot 8 - 1	HSA	1.0	1.1	1.8	2.4	4.6
AW0027B	Lot 8 - 1	HSA	1.0	1.1	1.9	2.8	6.2
AW0028B	Lot 8 - 1	HSA	1.0	1.1	1.9	2.8	6.2
AW0028C	Lot 8 - 1	HSA	1.0	1.1	1.9	2.8	5.9
AW0029UB	Lot 8 - 1	HSA	1.0	1.2	2.1	3.5	8.8
AW0030B	Lot 8 - 1	HSA	1.0	1.2	2.0	3.2	7.8
AW0031C	Lot 8 - 1	HSA	1.0	1.2	2.0	3.2	7.8
AW0032B	Lot 8 - 1	HSA	1.0	1.2	2.0	3.1	7.2

Injection Well	Vault	Method of Installation	Maximum Manifold Pressure at 0.5 gpm (psi)	Maximum Manifold Pressure at 1.0 gpm (psi)	Maximum Manifold Pressure at 2.0 gpm (psi)	Maximum Manifold Pressure at 4.0 gpm (psi)	Maximum Manifold Pressure at 8.0 gpm (psi)
AW0032C	Lot 8 - 1	HSA	1.0	1.1	2.0	3.0	7.0
AW0033C [a]	Lot 8 - 2	HSA					
AW0034B	Lot 8 - 1	HSA	1.0	1.1	1.8	2.6	5.4
AW0034C	Lot 8 - 1	HSA	1.0	1.1	1.9	2.8	5.9
AW0035B	Lot 8 - 2	HSA	1.1	1.3	2.3	4.1	11.4
AW0036B	Lot 8 - 2	HSA	1.1	1.2	2.3	4.0	10.9
AW0037C	Lot 8 - 1	HSA	1.0	1.1	1.9	2.8	6.2
AW0038B	Lot 8 - 2	HSA	1.1	1.2	2.2	3.9	10.4
AW0039UB	Lot 8 - 2	HSA	1.0	1.2	2.1	3.6	9.3
AW0040C	Lot 8 - 2	HSA	1.0	1.1	1.7	2.0	3.3
AW0041UB	Lot 8 - 2	HSA	1.0	1.0	1.6	2.0	3.1
AW0041C	Lot 8 - 2	HSA	1.0	1.0	1.6	2.0	3.1
AW0042UB	Lot 8 - 2	HSA	1.0	1.1	1.7	2.2	3.7
AW0042C	Lot 8 - 2	HSA	1.0	1.0	1.6	2.0	3.1
AW0043B	Lot 8 - 2	HSA	1.0	1.1	1.8	2.4	4.4
AW0043C	Lot 8 - 2	HSA	1.0	1.1	1.7	2.3	4.2
AW0044B	Lot 8 - 2	HSA	1.0	1.1	1.9	2.7	5.7
AW0044C	Lot 8 - 2	HSA	1.0	1.1	1.8	2.6	5.2
AW0045B	Lot 8 - 2	HSA	1.0	1.1	1.9	2.8	5.9
AW0045C	Lot 8 - 2	HSA	1.0	1.1	1.9	2.8	6.2
AW0046B	Lot 8 - 2	HSA	1.0	1.1	1.9	2.8	6.2
AW0047B	Lot 8 - 2	HSA	1.0	1.2	2.1	3.5	8.8
AW0048UB	Lot 8 - 2	HSA	1.0	1.2	2.1	3.4	8.3
AW0049C	Lot 8 - 2	HSA	1.0	1.0	1.6	1.9	2.8
AW0050C	Lot 8 - 2	HSA	1.0	1.0	1.6	1.8	2.4
AW0051UB	Lot 8 - 2	HSA	1.0	1.0	1.5	1.6	1.7

Injection Well	Vault	Method of Installation	Maximum Manifold Pressure at 0.5 gpm (psi)	Maximum Manifold Pressure at 1.0 gpm (psi)	Maximum Manifold Pressure at 2.0 gpm (psi)	Maximum Manifold Pressure at 4.0 gpm (psi)	Maximum Manifold Pressure at 8.0 gpm (psi)
AW0051C	Lot 8 - 2	HSA	1.0	1.0	1.5	1.6	1.7
AW0052C	Lot 8 - 2	HSA	1.0	1.0	1.6	1.8	2.6
AW0053UB	Lot 8 - 2	HSA	1.0	1.1	1.7	2.2	3.7
AW0053C	Lot 8 - 2	HSA	1.0	1.1	1.7	2.2	3.7
AW0054UB	Lot 8 - 2	HSA	1.0	1.1	1.7	2.3	4.2
AW0054C	Lot 8 - 2	HSA	1.0	1.1	1.7	2.2	3.9
AW0055UB	Lot 8 - 2	HSA	1.0	1.1	1.8	2.5	4.9
AW0055C	Lot 8 - 2	HSA	1.0	1.1	1.8	2.4	4.6
AW0056UB	Lot 8 - 2	HSA	1.0	1.1	1.9	2.8	5.9
AW0057UB	Lot 8 - 2	HSA	1.0	1.1	2.0	3.0	7.0
AW0058UB	Lot 8 - 2	HSA	1.0	1.2	2.0	3.2	7.8
AW0059C	Lot 8 - 2	HSA	1.0	1.1	1.7	2.3	4.2
AW0060UB	Lot 8 - 2	HSA					
AW0060C	Lot 8 - 2	HSA	1.0	1.1	1.7	2.1	3.5
AW0061C	Lot 8 - 2	HSA	1.0	1.1	1.7	2.3	4.2
AW0062C	Lot 8 - 2	HSA	1.0	1.0	1.6	1.9	2.8
AW0063UB	Lot 8 - 2	HSA	1.0	1.1	1.7	2.0	3.3
AW0063C	Lot 8 - 2	HSA	1.0	1.1	1.7	2.1	3.5
AW0064UB	Lot 8 - 2	HSA	1.0	1.1	1.8	2.4	4.4
AW0065UB	Lot 8 - 2	HSA	1.0	1.1	1.8	2.5	4.9
AW0065C	Lot 8 - 2	HSA	1.0	1.1	1.8	2.4	4.4
AW0066UB [b]	Lot 8 - 2	HSA	1.0	1.1	1.9	2.7	5.7
AW0067UB	Lot 8 - 2	HSA	1.0	1.1	1.9	2.8	6.2
AW0068UB	Lot 8 - 2	HSA	1.0	1.2	2.1	3.6	9.1
AW0069UB	Lot 8 - 2	HSA	1.0	1.2	2.1	3.4	8.3
AW0070C	Lot 8 - 2	HSA	1.0	1.1	1.8	2.4	4.4

Injection Well	Vault	Method of Installation	Maximum Manifold Pressure at 0.5 gpm (psi)	Maximum Manifold Pressure at 1.0 gpm (psi)	Maximum Manifold Pressure at 2.0 gpm (psi)	Maximum Manifold Pressure at 4.0 gpm (psi)	Maximum Manifold Pressure at 8.0 gpm (psi)
AW0071C	Lot 8 - 2	HSA	1.0	1.1	1.8	2.6	5.2
AW0072C	Lot 8 - 2	HSA	1.0	1.1	1.8	2.4	4.4
AW0073C	Lot 8 - 3	HSA	1.0	1.1	1.8	2.5	4.9
AW0074UB	Lot 8 - 3	HSA	1.0	1.1	1.7	2.1	3.5
AW0074C	Lot 8 - 3	HSA	1.0	1.1	1.7	2.2	3.7
AW0075UB	Lot 8 - 3	HSA	1.0	1.1	1.8	2.4	4.4
AW0076UB	Lot 8 - 3	HSA	1.0	1.1	1.8	2.6	5.2
AW0077UB	Lot 8 - 3	HSA	1.0	1.1	1.9	2.8	5.9
AW0078UB	Lot 8 - 2	HSA	1.1	1.2	2.2	3.7	9.8
AW0079UB	Lot 8 - 2	HSA	1.1	1.2	2.2	3.7	9.6
AW0080UB	Lot 8 - 2	HSA	1.1	1.2	2.2	3.9	10.4
AW0081C	Lot 8 - 3	HSA	1.0	1.1	1.8	2.4	4.6
AW0082C	Lot 8 - 3	HSA	1.0	1.1	1.7	2.2	3.9
AW0083C	Lot 8 - 3	HSA	1.0	1.0	1.6	1.9	2.8
AW0084C	Lot 8 - 3	HSA	1.0	1.0	1.6	1.8	2.4
AW0085C	Lot 8 - 3	HSA	1.0	1.1	1.7	2.0	3.3
AW0086B	Lot 8 - 1	HSA	1.0	1.1	1.9	2.7	5.7
AW0086C	Lot 8 - 1	HSA	1.0	1.1	1.9	2.8	5.9
AW0087B	Lot 8 - 1	HSA	1.0	1.1	1.8	2.4	4.6
AW0087C	Lot 8 - 1	HSA	1.0	1.1	1.8	2.5	4.9
AW0088C	Lot 8 - 1	HSA	1.0	1.1	1.8	2.4	4.4
AW0089B	Lot 8 - 3	HSA	1.1	1.2	2.2	3.7	9.6
AW0090UB	Lot 8 - 3	HSA	1.1	1.2	2.2	3.7	9.6
AW0091UB	Lot 8 - 3	HSA	1.1	1.2	2.2	3.9	10.4
AW0092C	Lot 8 - 3	HSA	1.0	1.1	1.7	2.0	3.3
AW0093C [c]	Lot 8 - 3	HSA	1.0	1.0	1.6	1.8	2.6

Injection Well	Vault	Method of Installation	Maximum Manifold Pressure at 0.5 gpm (psi)	Maximum Manifold Pressure at 1.0 gpm (psi)	Maximum Manifold Pressure at 2.0 gpm (psi)	Maximum Manifold Pressure at 4.0 gpm (psi)	Maximum Manifold Pressure at 8.0 gpm (psi)
AW0094C	Lot 8 - 3	HSA	1.0	1.1	1.7	2.1	3.5
AW0095C	Lot 8 - 3	HSA	1.0	1.0	1.6	1.8	2.4
AW0096UB	Lot 8 - 3	HSA	1.0	1.0	1.6	1.9	2.8
AW0097B	Lot 8 - 3	HSA	1.0	1.1	1.7	2.1	3.5
AW0098B	Lot 8 - 3	HSA	1.0	1.1	1.7	2.3	4.2
AW0099UB	Lot 8 - 3	HSA	1.0	1.1	1.8	2.5	4.9
AW0100B	Lot 8 - 3	HSA	1.0	1.2	2.1	3.4	8.3
AW0101UB	Lot 8 - 3	HSA	1.0	1.2	2.1	3.6	9.1
AW0102UB	Lot 8 - 3	HSA	1.1	1.2	2.2	3.7	9.6
AW0103C	Lot 8 - 3	HSA	1.0	1.1	1.7	2.3	4.2
AW0104C	Lot 8 - 3	HSA	1.0	1.1	1.7	2.3	4.2
AW0105C	Lot 8 - 3	HSA	1.0	1.1	1.7	2.1	3.5
AW0106B [d]	Lot 8 - 3	HSA	1.0	1.1	1.8	2.4	4.6
AW0107B	Lot 8 - 3	HSA	1.0	1.1	1.9	2.7	5.7
AW0108B	Lot 8 - 3	HSA	1.0	1.1	1.9	2.9	6.5
AW0109B	Lot 8 - 3	HSA	1.0	1.2	2.0	3.1	7.2
AW0110B	Lot 8 - 3	HSA	1.0	1.2	2.0	3.1	7.2
AW0111UB	Lot 8 - 3	HSA	1.0	1.2	2.0	3.2	7.8
AW0112UB	Lot 8 - 3	HSA	1.0	1.2	2.1	3.4	8.5
AW0113B	Lot 8 - 3	HSA	1.0	1.1	1.9	2.8	5.9
AW0114B	Lot 8 - 3	HSA	1.0	1.1	1.9	3.0	6.7
AW0115B	Lot 8 - 3	HSA	1.0	1.2	2.0	3.2	7.5
AW0116B	Lot 8 - 3	HSA	1.1	1.2	2.2	3.7	9.6
AW0117UB	Lot 8 - 3	HSA	1.0	1.2	2.1	3.4	8.3
AW0118UB	Lot 8 - 3	HSA	1.0	1.2	2.1	3.6	9.1
AW0119UB	Lot 8 - 3	HSA	1.1	1.2	2.2	3.7	9.8

Injection Well	Vault	Method of Installation	Maximum Manifold Pressure at 0.5 gpm (psi)	Maximum Manifold Pressure at 1.0 gpm (psi)	Maximum Manifold Pressure at 2.0 gpm (psi)	Maximum Manifold Pressure at 4.0 gpm (psi)	Maximum Manifold Pressure at 8.0 gpm (psi)
AW0120B	Lot 8 - 1	HSA	1.0	1.1	1.7	2.1	3.5
AW0122B	Lot 8 - 3	HSA	1.0	1.2	2.0	3.1	7.2
AW0123B [e]	Lot 8 - 3	HSA	1.0	1.2	2.0	3.2	7.8
AW0124B	Lot 8 - 3	HSA	1.0	1.2	2.1	3.5	8.8
AW0126B	Lot 8 - 3	HSA	1.1	1.2	2.2	3.7	9.8
AW0127UB	Lot 8 - 3	HSA	1.1	1.2	2.2	3.9	10.6
AW0129UB	Lot 8 - 3	HSA	1.0	1.2	2.0	3.1	7.2
AW0130B	Lot 8 - 3	HSA	1.0	1.2	2.1	3.4	8.3
AW0131B	Lot 8 - 3	HSA	1.0	1.2	2.1	3.6	9.1
AW0132B [b]	Lot 8 - 3	HSA	1.1	1.2	2.2	3.7	9.8
AW0133UB	Lot 8 - 3	HSA	1.1	1.2	2.3	4.1	11.1
AW0134UB	Lot 8 - 3	HSA	1.1	1.3	2.3	4.1	11.4
AW0166B	Lot 8 - 1	HSA	1.0	1.1	1.7	2.2	3.7
AW0167LB	Lot 8 - 1	HSA	1.0	1.1	1.8	2.4	4.4
AW0168LB	Lot 8 - 1	HSA	1.0	1.1	1.8	2.6	5.2
AW0169UB	Lot 8 - 1	HSA	1.0	1.1	1.9	2.8	5.9
AW0170LB	Lot 8 - 1	HSA	1.0	1.1	1.9	3.0	6.7

Notes

a No conveyance piping connecting shown to well in as-builts, but shown in vault detail as-builts. No piping length determined.
b Shown in as-built plan but unable to locate on vault detail as-built
c Piping length is an estimate; well is not shown connected in as-builts (but is near Vault 3)
d Piping length is an estimate; well is not shown connected in as-builts and is not shown on vault detail as-built.
e Shown as 123UB on as-built plan, 123B on vault as-built

Table 3
Equipment Inventory and Needs for Field Activities

Task	Item	Required	Available	To Obtain	Source	Comment
Hydraulic Testing	Water Meters	3 or 4	0	3 or 4	LADWP	3-4 days lead time
	Backflow preventer	1	1	0	TEM/JHA	
	Spin Down Filter	1	1	0	TEM/JHA	For filtering hydrant effluent
	Fire Hose	<1000 ft	1000 ft	0	TEM/JHA	
	Hose guard/ ramp	1	1	0	TEM/JHA	Need sufficient length to cross Harborgate Way
	Spill Kits	1	1	0	TEM/JHA	Hydrocarbon spill kit with adsorbents
	Injection Hose	500	>500	0	TEM/JHA	1" with camlock fittings
	Manifold	1	1*	0*	BRC	* Need to replace 1-in header with 3-in piping
	Compound Gauges	12	12	0	BRC	
	Flow meter/totalizers	12	12	0	BRC	
	Check valves	12	12	0	BRC	
	Gate valves	12	12	0	BRC	
	Well-head Fittings & Couplings	12	TBD	TBD	TEM/JHA	1" camlock fittings to 3/4" camlock (well head has female coupling)
	Dole 1.0 gpm valve	8	0	8	Dean Bennett	1" FNPT
	Dole 2.0 gpm valve	8	0	8	Dean Bennett	1" FNPT
	Dole 4.0 gpm valve	8	0	8	Dean Bennett	1" FNPT
	Dole 8.0 gpm valve	4	0	4	Dean Bennett	1" FNPT
	1" quick disconnect fittings	32	TBD	32	TEM/JHA	Need to attach Dole valves to manifold. Must be compatible w/ existing fittings on manifold.
Aquifer Performance Testing	Water Level Meters	2 or 3	0	2 or 3	CDM	For taking manual water level measurements during the test

Table 3
Equipment Inventory and Needs for Field Activities

Task	Item	Required	Available	To Obtain	Source	Comment
	Minitrolls	5 or 6	0	5 or 6	CDM	For taking continuous water level measurements during the test
	Laptop	1	1	0	CDM	Data downloading and field analysis
Aquifer Performance Testing (con't)	Development Rig	1	0	1	Driller	For installing the pump and setting up discharge from pumping wells to baker tanks
	Flow meter/totalizers	2	0	2	Driller	
	Check valves	2	0	2	Driller	
	Generator/power supply	2	0	2	Driller	
	pH, Temp, conductivity meter	1	0	1	CDM	To take groundwater parameters during the test
	Turbidity meter	1	0	1	CDM	To take groundwater parameters during the test
	Baker tanks	12	0	12	TEM/JHA	To contain water pumped during pumping test
	Connecting hose	1	0	1	CDM	Length to be determined by location of Baker tanks to the pumping wells
	Hose guard/ ramp	1	0	1	Driller	Safety

* Note: All quantities listed in table are based on using one manifold for hydraulic testing. If another manifold is used, quantities of all items except fire hydrant water meters will need to be increased accordingly.

4
Section Four

Section 4
Test Well Installation, Aquifer Testing and Groundwater Modeling

The purpose of this task is to determine aquifer hydraulic characteristics, assess leakage between the two aquifer zones (B-Sand and C-sand) and utilize site data to develop a groundwater flow and transport model suitable for supporting the design of the site remediation systems. This task will include installation of two extraction wells to facilitate aquifer testing in locations that are suitable for incorporation into the remedial design. Aquifer testing will be conducted at these wells, using available Site groundwater monitoring wells as observation wells. Results of the aquifer testing will be used to refine the existing reconnaissance level groundwater model for the Site. Modifications to the scope proposed herein may be done based on further evaluation of existing well testing data. For detailed information about groundwater conditions at the Site, please refer to previous site investigation and groundwater monitoring reports (Kennedy/Jenks Consultants, 2000a, England Geosystem/Haley and Aldrich, Inc., 2001, and Haley and Aldrich 2002b). Descriptions of the activities associated with this task are provided in the following sections.

4.1 Well Installation and Development Procedures

4.1.1 Well Installation

The two groundwater extraction wells will be installed using resonant sonic drilling techniques in preparation for aquifer performance tests (APTs) described in Section 4.2. The extraction wells will be named EW0004 and EW0005. The extraction wells will be constructed using V-shaped wire stainless steel screen and a PVC casing in order to allow efficient redevelopment. The casing and screen will be sized for the anticipated flow rates from the aquifer, including provisions for use of a pump shroud, if needed.

Where applicable, the work will be performed in accordance with the standard operating procedures (SOPs) for drilling, soil sampling, well installation, well development, and related activities (Haley & Aldrich, 2004a). Copies of the SOPs are included in Appendix B. Additional details and any deviations from the SOPs are provided below. Table 3 at the end of Section 3 provides the equipment inventory and needs for this phase of the project.

The general locations of the proposed wells are shown in Figure 5 included at the end of this section. Actual well locations will be adjusted in the field to be near the existing infrastructure (header lines, electrical conduits, etc.), as appropriate, to minimize surface disturbance. The following bullets provide a description of the key activities:

- Prior to any intrusive work, CDM will review utility information, including maps of the recently installed buildings and remediation infrastructure and conduct a Site visit to locate utilities, mark well locations, and determine Site clearing needs for drill rig access. Underground Service Alert will be notified a minimum of two working days in advance to allow adequate time for marking the locations of subsurface utilities. A geophysical survey will also be conducted at the locations for further utility clearance.

CDM will also coordinate with BRC, property owners, and tenants to minimize disruptions to Site activities.

- Prior to drilling, CDM will obtain the necessary well installation permits from the Los Angeles County Department of Health Services.

- The wells will be installed using resonant sonic techniques in order to minimize the potential for developing an interconnection between the B and C-Sand aquifers. For the C-Sand well, an 8 or 10-inch borehole will be drilled to the design total depth. 20 feet of 4-inch V-shaped stainless steel screen with slot size of 0.020-inch and Schedule 80 PVC casing assembly will be placed to the design depth. A gravel pack will be placed in the screen zone and the well cemented to the ground surface with an expansive grout. A similar method will used for constructing the B-Sand well, except that the well diameter will be 6 inches. In order to minimize the possible cross-contamination from the B-Sand, appropriately sized conductor casing will be installed to appropriate depths to seal off the B-Sand from the C-Sand. Water in the casing will be evacuated and then a smaller telescoping casing will then be installed within the conductor casing.

  If necessary, the C-Sand extraction well may be drilled using the double-cased hole method to prevent communication between the B- and C-Sand aquifers. The upper portion of the hole will be drilled to the confining unit separating the B and C-Sand aquifers (Middle Bellflower Mud [MBFM]) using resonant sonic techniques. An 8- or 10-inch ID casing will be installed and cemented in place through the MBFM. This upper casing will be installed in a borehole of sufficient diameter to allow cementing of the 10-inch casing in place by use of tremmie placement within the annulus between the drilled borehole and the casing. A drillable plug will be placed in the lower section of the casing. After this cement grout is set, drilling of the borehole will continue into the C-Sand aquifer using drilling fluids that are designed to minimize formation plugging. The well will be completed using a 4-inch V-slot stainless steel screen through the C-Sand aquifer, with 4-inch blank casing installed to the ground surface. The screen will be gravel-packed, then sealed into the 8 or 10-inch casing using an expansive cement grout. No protective casing will be required for the B-Sand well.

  The well construction details for the extraction wells will be recorded on field forms.

- Soil cuttings will be placed in 55-gallon drums or roll-off bins placed near the borings and moved to an approved on-site location.

- Soil samples for will be taken from the borings for both the wells for use in treatability testing, as described in Section 5. A total of about 5 kg of soil is required from each boring for the treatability test. This soil will be collected from the saturated zone interval containing the most impacted soil based on field screening results (visual, olfactory and OVA headspace screening). Saturated soil will be packed into 10 eight-ounce jars and the jars will be topped with groundwater and sealed. These jars will be shipped overnight on ice to the CDM Environmental Treatability Laboratory in Bellevue, Washington. In addition, ten liters of groundwater will be required for the treatability test. Groundwater will be collected from well IRZMW001A and placed in one-liter bottles. These bottles will be placed on ice and shipped overnight to the CDM laboratory along with the soil. Standard well purging and low-flow sampling procedures will be used for sample collection. Samples will be collected after field parameters (i.e., DO, pH, specific conductivity, temperature, and ORP) have stabilized. Samples collected for treatability analysis do not need to adhere to the EDMS protocol, since they will not result in an electronic data deliverable.

- CDM's drilling subcontractor will develop the new wells to remove particulates and condition the filter pack.

- Each well will be surveyed for location and elevation. Well locations and well-head elevations will be surveyed to the nearest 0.5 feet and 0.01 foot, respectively, at a marked reference point on each well casing. Horizontal coordinates and vertical elevations will be established using North American Datum of 1983 (NAD 83) and North American Vertical Datum of 1988 (NAVD 88), respectively.

- The drilling subcontractor will submit well completion forms to Los Angeles County Department of Health Services.

- Investigation derived waste (IDW) (e.g., drill cuttings, development water) will be containerized, labeled, characterized, and properly stored pending laboratory analyses and disposal determination. The IDW will be properly manifested and disposed by CDM following receipt of laboratory results. IDW characterization samples collected will adhere to the Data Management Plan (CH2M Hill, 2002). For more information, refer to Appendix B, SOP #4.

4.1.2 Well Development

Development of wells will consist of initial development (pre-development) during construction of the well, to settle the filter pack, and development of the well a minimum of 72 hours following placement of the surface seal to remove drilling fluids and fines from within the screen zone and increase hydraulic communication with the formation of the water bearing units. This task will consist of the following activities:

- Before development, static groundwater levels will be measured in the extraction wells and the surrounding observation wells.

- Well development will consist of mechanical surging or jetting followed by bailing and pumping of the well. The purpose of this development is to remove drilling fluids and fines from within the aquifer adjacent to the screen zone. Bailing and pumping methods will be used in combination to remove water containing suspended fine-grained material and to induce groundwater flow through the filter pack into the well.

- IDW including drill cuttings, development water, etc., will be stored in 55-gallon drums, the tank in the SVE compound located at the northeastern corner of Lot 8, or other additional approved containers as needed and stored on-Site at a location selected by BRC pending laboratory analyses and disposal determination. The IDW will be properly manifested and disposed of by CDM following receipt of laboratory results. IDW characterization samples collected must adhere to the Data Management Plan (CH2M Hill, 2002). For more information, refer to Appendix B, SOP #4.

4.2 Aquifer Testing Procedures

Aquifer performance tests (APTs) involve the extraction of groundwater from a well at a measured rate. Water levels are monitored in the test well and at nearby locations. Wells located nearby but screened in adjacent aquifers will also be monitored to assess hydraulic communication between zones further. The change in head (difference between static water level and water levels during pumping) over the period of the test provides the basis for evaluating aquifer characteristics. CDM will also attempt to utilize any available aquifer tests data in conjunction with other applicable data obtained during previous characterizations.

The following tasks will be performed for each of the APTs for the two wells:

- Data loggers will be installed in the extraction well and adjacent existing monitoring wells. Manual water level measurements will be taken in available surrounding monitoring and observation wells.

- Water levels will be measured electronically at all measuring points using In-situ Mini-Troll transducers/data loggers. Back-up measurements will be collected manually using an electric well sounder throughout the test.

- For each test, an electric submersible pump will be installed in the test wells. The pump intake will be set near the top of screen. Discharge will be measured using a calibrated inline flow meter. Discharge rates will be controlled using a ball or globe valve installed downstream of the flow meter.

- Groundwater parameters consisting of pH, temperature, conductivity and turbidity will be measured on a regular frequency during the APTs.

- Samples for analysis of volatile organic compounds (VOCs) by EPA Method 8260B will be collected after 15 minutes of pumping and at the end of 24 hours of pumping. Samples will be stored on ice in a cooler and transported by courier to a California-certified analytical laboratory for analysis under proper chain-of-custody. Chain of custody forms will be maintained throughout sample collection and transport. Samples collected must adhere to the Data Management Plan (CH2M Hill, 2002). For more information, refer to Appendix B, SOP #4.

- A step drawdown test will first be performed in the extraction wells to determine the appropriate pumping rate for the subsequent constant rate APT.

- For the constant rate test, each extraction well will be pumped at a continuous rate for 24 hours at a projected rate of 15 gpm in each of the B- and C-sand zones, with the actual constant rate to be determined following the step drawdown test.

- For the constant rate test, groundwater levels will be monitored in the piezometers (existing monitoring wells) and extraction well over an estimated 3-day period (1 day of background to establish static water levels, 1 day during performance of the APT, and 1 day of recovery).

- IDW (e.g., APT water) will be stored in 55-gallon drums, the tank in the SVE compound, or other additional approved containers as needed and stored on-Site at an approved location pending laboratory analyses and disposal determination. The IDW will be properly manifested and disposed of by CDM following receipt of laboratory results. IDW characterization samples collected must adhere to the Data Management Plan (CH2M Hill, 2002). For more information, refer to Appendix B, SOP #4.

- The results of the APTs will be analyzed using standard groundwater analytical techniques to determine the estimates of horizontal hydraulic conductivity, transmissivity, specific capacity, and well efficiency.

4.3 Modeling Protocols

An existing reconnaissance level groundwater model will be refined and calibrated to site data, including results from the aquifer tests. Please note this reconnaissance level model has been updated to a certain degree as part of the design of the early remediation infrastructure activity being performed. Existing boring logs at the Site will be analyzed to refine the characteristics of the potentially discontinuous confining layer separating the B-Sand and C-Sand aquifer zones. The results of the aquifer test in the C-Sand will be assessed to determine if extension of the model to the Gage Aquifer is necessary for the flow model. The model will extend a sufficient distance upgradient and downgradient of the Site to minimize the impact of boundary conditions on the Site simulations. To the extent that data are available, the downgradient extent of the model will consider the location of remediation systems under design at adjacent sites, especially the Montrose Chemical and Del Amo Superfund Sites.

CDM plans to use the same suite of models used by EPA for the Montrose Chemical and Del Amo Superfund Sites (CH2M Hill, October 2004). These include MODFLOW-2000 for flow modeling, MODPATH for particle tracking, MT3DMS for transport, and PEST for calibration assistance. The groundwater flow model will consist of 3 layers representing: the B-Sand; the MBFM which is a fine-grained silt and clay layer locally separating the B and C-Sands; and the C-Sand. If the Gage Aquifer is modeled, then an additional two layers will be added to model the Lower Bellflower Aquitard (LBF) and the Gage aquifer. The model will be configured in a grid-independent manner to facilitate design evaluations that may require grid refinements to assess donor solution delivery. The model framework will be configured based on analysis of Site and area boring logs. Initial estimates of hydraulic characteristics will be configured based on aquifer test results from the Site and adjacent areas. Upgradient and downgradient boundaries will be defined as general head boundaries. Calibration of the model will be accomplished by varying sensitive parameters that have the greatest uncertainty in their field values. The calibration will be assessed by comparing simulated and observed water levels at the Site under steady-state conditions, and flow directions are consistent with the distribution of contaminants at the site. Attempts will also be made to calibrate the model using transient conditions such as the pumping tests data and other time variant stresses, such as seasonal pumping at nearby production wells, are identified. The calibration will attempt to match water levels within less than 0.5 feet at 70 percent of the wells.

After refinement of the site model, it will be used to assess optimal designs for donor solution delivery, timing of recirculation operations, and placement of additional wells for the proposed recirculation system.

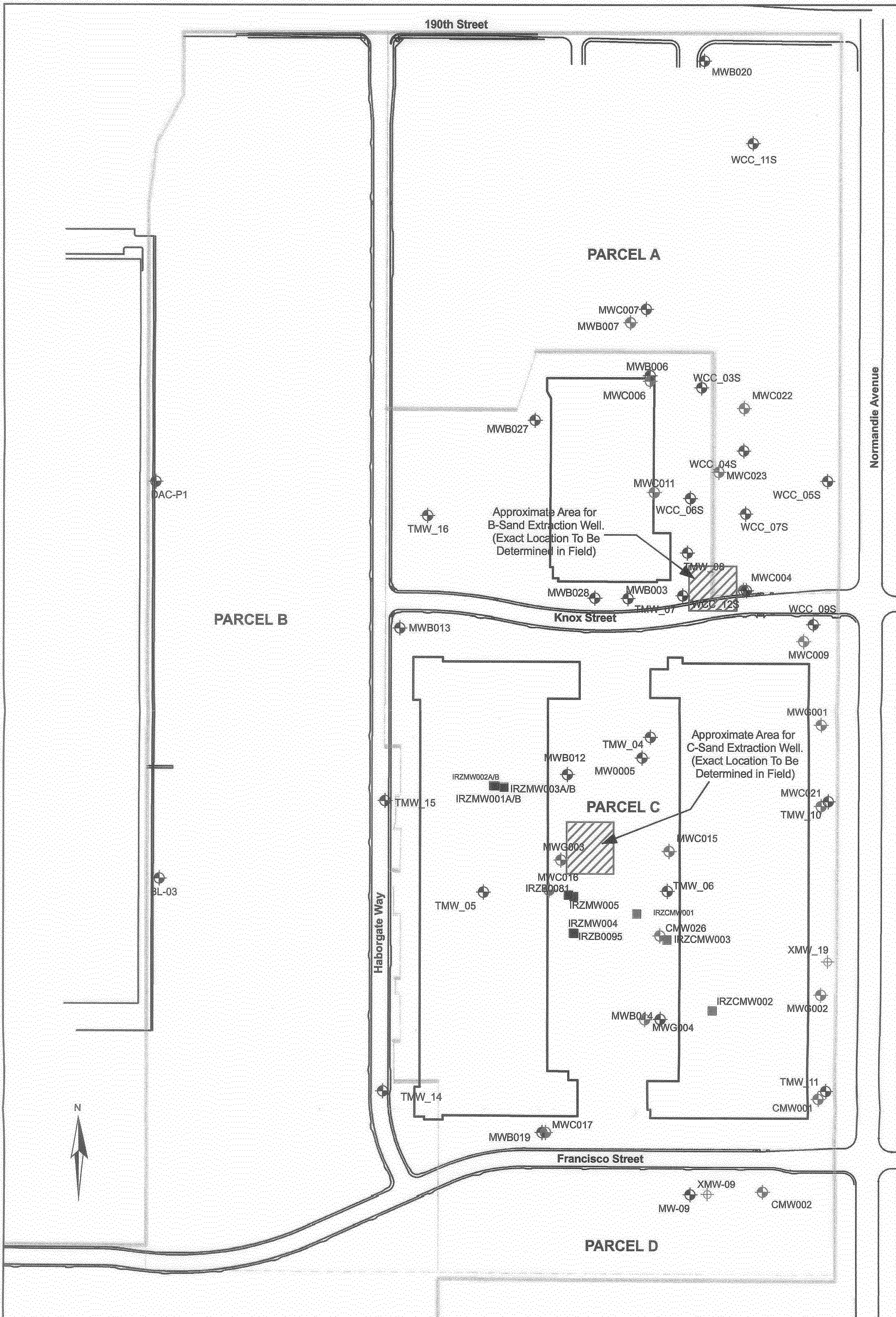
4.4 Data Evaluation and Reporting

Following completion of the proposed wells, aquifer testing, and groundwater modeling, a draft technical memorandum will be prepared for BRC's review. The memorandum will consist of the following key items:

- Summary of field activities, including copies of boring logs and well completion diagrams, results of survey, monitoring results during the aquifer testing program and analysis of aquifer test results. The memorandum will also document the handling of produced waters from the testing program.

- The modeling portions will describe the site conceptual model and its implementation in the numerical model. This memorandum will include descriptions of the site hydrogeology, aquifer characteristics, fate and transport characteristics and boundary conditions used in the model. The basis for selection of each parameter will also be provided. The model calibration will be described and will include description of uncertainties, and a sensitivity analysis for significant parameters. The final results for each remediation scenario that is evaluated will be provided in the memorandum. Model files in electronic format will be included in an attachment to the memorandum, to facilitate independent review of the model and results.

The memorandum will be finalized upon receipt and consideration of comments from BRC.



0 250 500

Feet

Parcel Boundary

Property Boundary

Proposed Extraction Wells

B-Sand Monitoring Well

C-Sand Monitoring Well

Gage Monitoring Well

Montrose

B-Sand IRZ Bioremediation Monitoring Well

C-Sand IRZ Bioremediation Monitoring Well

CDM

Figure 5

Boeing Realty Corporation
Former C-6 Facility

Proposed Extraction Wells in B-Sand and C-Sand

5

Section Five

Section 5

Section 5
Treatability Testing and Electron Donor Evaluation

An electron donor evaluation will be conducted to identify the most suitable electron donor compound(s) for use in the proposed remediation at the Site. Various cost-effective electron donors including ethanol, isopropanol, citric acid, sodium citrate, whey, acid whey, lactose, lactic acid, various polyols, fermentation mother liquors (i.e., waste products of commercial fermentation processes), high fructose corn syrup, corn syrup, and molasses are being considered for use at the Site. The polyols and fermentation mother liquors are proprietary products preliminarily identified by JRW and are subject to a non-disclosure agreement between JRW and CDM. In addition, the evaluation will identify potentially necessary design, operations, and maintenance requirements associated with injection of the electron donor(s). In order to appropriately consider the factors that affect electron donor selection, the evaluation will be conducted in two phases – a background "paper" evaluation and a laboratory treatability study.

5.1 Paper Evaluation

A preliminary "paper evaluation" will be conducted in order to determine which donors are suitable for testing. Factors to be considered in this evaluation include:

- Potential for stimulating complete reductive dechlorination to ethene with commercially available bioaugmentation cultures;
- Electron donor degradation rate;
- Electron donor specific reducing power and unit cost;
- Dissolution and mixing (for solid products), filtration, and other pretreatment requirements;
- Compound stability and potential for precipitation or fermentation under ambient storage conditions;
- Potential for biofouling amendment wells;
- Flammability and associated infrastructure requirements (i.e., Class I, Division I electrical);
- Potential electron donor licensing requirements and fees;
- Permitting requirements including LARWQCB WDRs; and
- Capital costs for storage and handling equipment specific to each donor.

The potential for biofouling will be evaluated by reviewing internal CDM experience, conducting a literature review, and interviewing other experts in the field. This knowledge will be leveraged to identify electron donors with lowest tendency for biofouling. In addition, biofouling control strategies such as electron donor pulsing, injection of very high electron donor concentrations, or injection of biofouling control reagents such as hypochlorite will be evaluated. As part of the existing data evaluation, the Arcadis Bioremediation Amendment Recommendation Memo (Arcadis, 2004c) will also be reviewed to obtain further data for this task.

Flammability is relevant to ethanol and isopropanol which are being considered. The safety concerns and necessary design and operations requirements associated with flammable electron donors must clearly be outweighed by distinct advantages to warrant their recommendation. Nevertheless, it is premature to eliminate these compounds at this stage because of their demonstrated effectiveness at other sites and their relatively low cost.

Permitting requirements will be identified and are anticipated to include at a minimum the LARWQCB WDRs. Certain electron donors including lactate, ethanol, propanol, complex sugars such as molasses and corn syrup, and food process byproducts such as milk whey are included under the general WDR (Order No. R4-2005-0030: Series 007). Other electron donors such as citric acid would require a site-specific WDR. In the case of flammable electron donors (e.g., ethanol and isopropanol) a Los Angeles City Fire Department permit will be required. Ethanol would also require a specially denatured alcohol (SDA) permit from the Bureau of Alcohol, Tobacco, and Firearms (ATF).

Electron donor costs will be determined by obtaining quotations from vendors. Transportation, storage, and handling costs will be considered in addition to raw chemical costs. These costs are related in part to the engineering infrastructure required for certain electron donors (e.g., explosion proof requirements for the alcohols).

One of the results of the preliminary paper evaluation will be to identify electron donors that will be further evaluated through laboratory treatability testing, described in Section 5.2.

5.2 Laboratory Treatability Testing Plan

The second phase of the electron donor evaluation is the laboratory treatability testing. The factors to be evaluated during the testing include:

- Mixing, filtration, or other pretreatment requirements.
- Compound stability and potential for precipitation or fermentation under ambient storage conditions.

- Potential for stimulating complete reductive dechlorination to ethene with commercially available bioaugmentation cultures.
- Relative electron donor degradation rate.

Pretreatment requirements and stability characteristics of particular electron donor candidates will be evaluated initially. Electron donor products identified as being promising in the "paper evaluation" described in Section 5.1 will be further evaluated with respect to physical properties and stability. Specific measurements will include insoluble residuals in solid products, suspended solids concentrations in liquid products, determination of filtration requirements using different pore-size filters, and stability of complex electron donor solutions with respect to fermentation or precipitation. The results of these analyses and the results of the paper evaluation will be used to select six electron donor products for the biotreatability test described below.

Soil and groundwater samples will be collected during the extraction well installation described in Section 4, for use in conducting the treatability study. The biotreatability tests will be conducted for the identified electron donor products and three different commercially available bioaugmentation cultures obtained from SiRem, Shaw, and Bioremediation Consulting, Inc. Prior to use of any one of these cultures, discussions concerning availability, cost, quality assurance/quality control (QA/QC), and potential inhibition of the cultures by 1,1,1-TCA or chloroform will be held with the vendors. Concentrations up to 580 μg/L of 1,1,1-TCA in the northern portion of the Former Building 1/36 area (J-flagged concentration in Well MWB006 in the December 30, 2005 sample) and up to 3,000 μg/L chloroform in the southern portion of the Former Building 2 area (Well MWB019, September 22, 2005 sample) have been measured. Recent treatability testing conducted by CDM demonstrated that TCE was rapidly and completely dechlorinated by the Shaw culture in the presence of 200 to 300 μg/L 1,1,1-TCA. Thus the primary concern, if any, is the chloroform plume near Francisco Street. The results of these vendor discussions and CDM experience will be used to assess the risk associated with these potentially inhibitory VOCs.

Tests will be conducted in serum bottles containing soil, groundwater, electron donor, and bioaugmentation culture. A total of 18 test conditions (i.e. 6 electron donors X 3 bioaugmentation cultures) are planned. In addition, two control tests , one of which is sterilized, will be conducted involving no electron donor or bioaugmentation culture. Thus there will be a total of 20 conditions (i.e., 18 with electron donors and 2 controls) and each condition will be conducted in duplicate for a total of 44 bottles. Each 250-milliliter bottle will be amended with 50 grams soil and 150 milliliters groundwater. The bottles will be sealed with butyl rubber stoppers and made anoxic by repeated evacuation and filling with nitrogen gas. TCE will then be added at a concentration of 1,000 μg/L. Depending on the site-specific potential for inhibition of reductive dechlorination by 1,1,1-TCA or chloroform, these compounds may also be added to the microcosms. Electron donors will be added at a concentration of 1,000 mg/L.

Bioaugmentation cultures will be added at one percent by volume. The microcosms will be mixed and stored upside down in the dark at room temperature.

Groundwater and headspace samples will be collected after two days of equilibration and biweekly for three months. These samples will be analyzed in the CDM treatability laboratory by purge and trap gas chromatography for TCE, cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride (VC). Groundwater samples will also be analyzed for pH and sulfate. Headspace samples will be analyzed for methane and ethene.

Additionally, pretreatment requirements and stability characteristics of particular electron donor candidates will be evaluated. Specific measurements will include suspended solids concentrations in certain products, stability of complex electron donor solutions with respect to growth of bacterial contaminants and precipitation, solubility of dry products (e.g., whey powder and lactose), and identification of filtration requirements (e.g., particle retention size).

The background evaluation will be continually refined as appropriate based on the findings of the laboratory treatability study.

5.3 Data Evaluation and Reporting

Following completion of the donor evaluation, CDM will prepare a draft technical memorandum for BRC's review. The memorandum will provide a summary of the results of the background evaluation and the laboratory treatability testing procedures and provide recommendations on the preferred electron donor (s) and bioaugmentation cultures for use at the Site.

The memorandum will be finalized upon receipt and consideration of comments from BRC.

6 Section Six

Section 6
Electron Donor Injection Test

6.1 Purpose

An electron donor injection test will be performed based on the results of the electron donor evaluation described in Section 5. The reasons for this test include:

- Verification that electron donor injection flow rates and pressure will be similar to those obtained using water injection as described in Section 3;
- Estimation of biofouling potential with the selected electron donor(s) and the commensurate need for biofouling control strategies;
- Validation of the electron donor consumption rate estimate obtained from the laboratory electron donor treatability test; and
- Verification of potential for surface seepage through the well or the well field footprint.

An assessment of these needs will be made following completion of the evaluations described in Sections 3 through 5 and discussed with BRC. If warranted, electron donor injections testing will be conducted in accordance with the procedures described in Section 6.2.

6.2 Testing Plan

Detailed procedures are not presented at this time and will be developed following completion of the water injection tests and the electron donor evaluation tests. The general approach is only presented at this time.

The electron donor injection test will vary depending on the purpose of the test. For example, if testing is needed for the first and/or fourth reasons listed above, then this could be accomplished using short-term and/or long-term tests involving injection of one or more electron donors into existing wells and monitoring physical parameters such as flow rate, injection volume, and pressure at the injection points. If testing is needed for the second and third reasons listed above, then groundwater samples may need to be collected for the purpose of estimating electron donor transport rates. While the exact procedure is yet undefined, the following paragraphs provide a general description of testing that is anticipated.

- Injection of the optimal electron donor(s) would be conducted in existing amendment wells. The wells will be selected based on results of evaluations described in Section 3, depth and location of the screened interval, and proximity to existing monitoring wells. The source of water would be a fire hydrant, with sodium bisulfite or another acceptable oxygen scavenger added to remove dissolved oxygen and chlorine.

- Water would be injected continuously at a flow rate determined during the tests described in Section 3 and concentrated electron donor solution would be periodically injected into the water using chemical feed pumps and chemical tanks. A tracer (e.g., bromide) will be mixed with the electron donor prior to injection. The frequency of pulsing and the electron donor injection concentration may be varied amongst the different wells to identify the best injection strategy.

- Well heads will be instrumented with flow meters and pressure transducers or gauges and the data will be recorded manually or on a data logger. Groundwater samples may be collected from nearby monitoring wells or unused amendment wells and analyzed for relevant analytes. These analytes may include temperature, pH, oxidation-reduction potential, sulfate, dissolved oxygen, ferrous iron, total organic carbon, bromide tracer, and VOCs.

The results and conclusions from this test will be incorporated into the technical memorandum for Treatability Testing and Electron Donor Evaluation.

7 Section Seven

Section 7
Data Presentation and Evaluation

All information collected from hydraulic injection testing, aquifer testing, treatability testing, and all other pre-remediation activities will be presented in technical memorandums to BRC as described in the various sections. Tables, graphs, and figures summarizing collected data will be included as appropriate. The information developed from these pre-remediation activities will be used during the design of the remediation system infrastructure. Presentation of results from future electron donor testing is discussed in Section 6.

All analytical laboratory reports will be submitted electronically to CH2M Hill who will provide project data management. Copies of the final reports and memorandums will be uploaded to the Boeing Environmental Data Management System (BEDMS) portal.

8

Section Eight

Section 8
Project Schedule

The project schedule will be determined following completion of the Focused Feasibility Study and selection of a preferred remedial alternative.

9
Section Nine

Section 9

Section 9
Spill Prevention and Contingency Plan

Some of the planned pre-remediation field activities necessitate the development of spill prevention and contingency plans. This section is intended to present guidance to prevent spills and procedures for response in the event of a spill.

9.1 Spill Prevention

Field staff will undertake preventative measures to prevent spills at all times. This includes but is not limited to the following actions:

- Field staff will handle chemicals with appropriate care. Drums and other chemicals containers will be moved and stored in a manner consistent with their contents.

- Transport of all chemicals will be done with proper equipment. For example, all 55-gallon drums must be moved with a drum dolly or comparable equipment to prevent spills. Field staff will not attempt to move more than can be handled safely.

- Pumps, manifolds, chemical containers, and other liquid-containing will be placed in portable secondary containment as needed to contain small spills and drips that may occur during testing and injection. Large containers (i.e. 55-gal drums) are not subject to this requirement only while being moved. Long runs of hose and very large containers (i.e. the tank in the SVE compound) are not subject to this requirement, but must be inspected regularly as stated below.

- Field staff will have maintain spills kits and other appropriate spill response equipment present while onsite and working. Spill kit contents will include shovels, sorbent pads, plastic bags, towels, berms, and personal protective equipment. Sorbent materials will be capable of controlling the compounds of concern at the site as discussed in Section 1.2 and also any other chemicals brought on site, including petroleum hydrocarbons, electron donor chemicals, other miscellaneous chemicals. Field staff will periodically verify that spill kits are complete and will replace contents if and when they are used.

- Field staff, while conducting routine injection procedures, will also perform visual inspections of the interior of the associated building, exterior of the injection vaults, and associated injection equipment on a daily basis and while injection is occurring (as noted in Appendix B, SOP #2). Any deficiencies noted from these examinations will be documented and corrected immediately.

- Personnel who operate injection equipment, decontamination equipment, drilling equipment, at the Site will be required to have training in the operation and maintenance of the equipment, injection procedures, general facility operations, and the contents of this work plan.

- Spill prevention and control will be discussed in daily tailgate meetings. All field staff will understand where the spill kits are located and how they are to be used. Field staff will also understand the reporting procedures in Appendix D.

- Additional training will be conducted if a spill occurs, when existing operating systems are modified, when personnel responsibilities change, or when this plan is amended.

9.2 Site Activities and Contingencies

This work plan includes several different pre-remediation activities, each that has potential to lead to different types of contingencies. Therefore, different actions may be required for different pre-remediation activities.

Although hydraulic testing of existing infrastructure is not anticipated to generate any water that has been impacted by VOCs present at the site, surface leakage from existing infrastructure must be handled with immediate concern. If a surface leakage from an injection well is observed or suspected, injection to the involved wells will be discontinued immediately and contingency procedures will be implemented as described in Section 9.3.

Installation of future extraction wells for aquifer testing will include the generation of IDW in the form of soil cuttings, groundwater from purging, development, and testing activities, and decontamination water. This IDW will likely contain VOCs indicated in Section 1.2 and must be handled appropriately, as indicated in Section 4. IDW characterization samples collected must adhere to the Data Management Plan (CH2M Hill, 2002). For more information, refer to Appendix B, SOP #4.

If electron donor injection activities presented in Section 6 are performed, this section will be appended as needed to address any contingencies associated with that field work.

9.3 Contingency Plan

If soil cuttings or other solid material is spilled during pre-remediation field activities, field personnel will use shovels, brooms, and other equipment as necessary to clean up the impacted area. Field staff will contact the TEM Project Manager, Greg Gibbs, and the CDM Project Manager, Ravi Subramanian, to discuss the spill. If the spill is too large to be controlled easily with a broom and a shovel and/or if it requires cleanup of a parked vehicles and tenant or private property, field staff will initiate the reporting procedures identified in Appendix D.

If injection fluids, IDW water, or other liquid solution is spilled or surface leakage is observed during pre-remediation field activities, field staff will employ the spill kits and equipment contained therein to contain, control, remove spilled material and prevent discharge of the chemicals and injection fluids to the storm drain system and other sensitive receptors. Field staff will also attempt to address slip hazards.

If the spill is a minor spill (i.e. less than 150 gallons, can be immediately contained, and does not requires cleanup of a parked vehicles and tenant or private property), field staff will initiate the minor spill reporting procedures identified in Appendix D.

If the spill is a major spill (greater than 150 gallons, cannot be immediately contained and controlled, or if requires cleanup of a parked vehicles and tenant or private property), field staff will initiate the major spill reporting procedures identified in Appendix D.

All spend adsorbents and other cleanup materials will be stored in 55-gallon drums, or other additional approved containers as needed and stored on-Site at a location selected by BRC pending laboratory analyses and disposal determination. The cleanup materials will be properly manifested and disposed of by CDM following receipt of laboratory results.

Field staff will contact an emergency response contractor in the event of an uncontrolled release in which on-site spill equipment is insufficient to contain and clean up a spill. Potential emergency response contractors shall be identified on tailgate meeting forms and prior to initiation of injection activities.

10

Section Ten

Section 10
Housekeeping and Residuals Management

10.1 Housekeeping and Site Cleanup

Site work area will be maintained in a clean and orderly fashion during site work, so as to minimize impact to the Site and cleanup at the end of the day.

All fire hoses connected to the hydrants and corresponding hose-guards for protection for vehicular traffic will be left in place only as long as needed for use. Once the hoses are no longer needed, the fire hose and hose-guards will be removed.

At the end of each day, field staff will take steps to clean the work area. All in-line valves in the vaults will be closed. All transfer hoses will be disconnected. All field equipment will either be stored onsite in a secure location, such as the SVE compound or offsite. No equipment will remain staged in vaults. All vaults will be cleaned and pumped down as needed using the sump in the vault and a submersible pump. Water will be containerized as necessary and disposed properly.

Spill prevention and control is discussed in Section 9.

10.2 Drilling Activities

IDW handling, characterization, and disposal is described in Section 4.

11

Section Eleven

Section 11

Section 11 Project Metrics

All information collected from hydraulic injection testing, aquifer testing, treatability testing, and any other pre-remediation activities will be used during the design of the injection system infrastructure.

Successful pre-remediation activities will include completion of hydraulic testing, aquifer testing, treatability testing, and all other field activities without any health and safety incidents.

12

Section Twelve

Section 12
Project Management

The roles and responsibilities for each project member are presented in Table 4 at the end of this section. This table displays the tasks necessary for completion of these pre-remediation field activities, personnel responsible for each activity, and contact information and affiliation for all listed personnel. Project communication pathways are also described therein.

Table 4
Roles and Responsibilities for the Project Team

Name and Email	Company	Contact Information	Role	Responsibilities
Robert Scott Robert.P.Scott2@boeing.com	Boeing	O-(562)-733-2229 M-818-620-2527	Senior Boeing Project Manager	· Provide overall management of project. · Track project performance. · Interface and coordinate with regulatory agency representatives. · Conduct cost control. · Schedule and coordinate project status meetings. · Review, resolve issues, and approve all proposals, change orders, and invoices. · Ensure that work is being performed in accordance with proposal/contract/schedule/budget. · Manage, track, and report all costs and budgets. · Direct communications with managers and implementers. · Communicate with adjacent property owners; coordinate site access as required.
Joe Weidmann JWeidmann@haleyaldrich.com	Haley & Aldrich		Boeing Project Manager	· Act as lead with directly responsibility for all aspects of project performance and compliance. · Coordinate review of all significant documents. · Review work plans and reports before they are sent to project Manager. · Ensure that work is performed in accordance with established. · Conduct quality assurance/quality control (QA/QC) activities. · Communicate/coordinate with property owner.
John Scott john.r.scott@boeing.com	Boeing	O-(562)-586-4533 M-(818)-519-9884	Remediation Engineering Technical Review	· Provide peer review of remediation plans and documents for technical correctness and consistency with Boeing policies and procedures. · Review remediation system design, construction, and operation.

Table 4
Roles and Responsibilities for the Project Team

Name and Email	Company	Contact Information	Role	Responsibilities
Dennis Carlson Dennis.Carlson@boeing.com	Boeing		Field Oversight	. Review Implementation work plan. . Provide access for field activities.
Ravi Subramanian SubramanianR@cdm.com	CDM	O-(949)-752-5452 M-(714)-308-2945	CDM EISB Project Manager	· Prepare bioremediation work plan. · Prepare implementation plan. · Provide QA/QC and technical oversight of amendment activities. · Ensure that work is being performed in accordance with proposal/contract/schedule/budget. · Subcontract TEM/JHA to perform implementation.
Pat Evans EvansPJ@cdm.com	CDM	O-(425)-453-8383	EISB Technical Specialist	· Develop implementation plan. · Provide QA/QC and technical oversight of infrastructure assessment and remediation. · Lead treatability study.
Mike Smith smithmj@cdm.com	CDM	O-(303)-298-1311	EISB Hydrogeological Lead	. Oversee well installation and aquifer performance tests (APTs). · Lead groundwater modeling efforts.
Pearl Pereira PereiraPJ@cdm.com	CDM	O-(949)-752-5452 M-(714)-904-8810	Project Geologist	· Act as field geologist for installation of extraction wells and APTs. · Coordinate and schedule subcontract drilling firm for well installation, development, and APTs. · Coordinate with BRC regarding site access and restrictions and storage of IDW pending profiling and disposal. · Analyze APT data. · Perform groundwater modeling in conjunction with and under the guidance of EISB hydrogeological lead.

Table 4
Roles and Responsibilities for the Project Team

Name and Email	Company	Contact Information	Role	Responsibilities
Pearl Pereira PereiraPJ@cdm.com	CDM	O-(949)-752-5452 M-(714)-904-8810	Waste Disposal	· Inventory on-Site waste and ensure labeling compliance. · Collect waste profile samples and transmit of lab results to BRC. · Select waste transport service provider. · Select waste disposal facility for BRC approval. · Coordinate preparation of waste manifests with waste transport service provider for BRC approval. · Submit final waste disposal documentation to BRC.
Jeff Bamer BamerJT@cdm.com	CDM	O-(425)-453-8383 M-(206)-321-9687	Project Engineer	· Critically evaluate injection infrastructure. · Coordinate implementation of field program. · Prepare guidance documents and tracking forms for field implementation.
Kent Sorenson/Ryan Wymore	CDM	O-(303)-298-1311	EISB Technical Specialists	· Provide QA/QC and technical oversight of EISB.
Sanjay Vancheeswaren Sanjay.Vancheeswaran@CH2M.com	CH2MHill	0 - (714)-435-6156	Data Management	· Administers the BEDMS for the project. · Enforces the requirements of the Data Management Plan. · Coordinates and verifies the delivery of the data/information between the project team members. · Maintains the project goldcopy basemap · Uploads and maintains project GIS theme maps · QA/QCs data quality and completeness and reports to project team · Submits state required EDD's (Geotracker)
Greg Gibbs ggibbs@jacobandhefner.com	JHA	O-(949)-453-1045 M-(714)-719-6856	Implementation Project Manager	· Provide general implementation oversight. · Schedule and execute implementation plan. · Select project staff and coordinate field staff. · Manage, track, and report all implementation costs. · Ensure that work is being performed in accordance with implementation plan and budget.
TBD	JHA		Field Implementation Lead	· Develop site-specific system layout for EISB injections. · Collect injection data for daily operation. · Ensure data is transferred daily to EISB team.

Table 4
Roles and Responsibilities for the Project Team

Name and Email	Company	Contact Information	Role	Responsibilities
TBD	TEM/JHA		Field Technician	· Set up injection manifolds. · Perform daily system startup, and monitoring and performance of injection tests. · Troubleshoot injection issues or equipment issues.
TBD	TEM/JHA		Waste Disposal	· Inventory on-Site waste and ensure labeling compliance. · Collect waste profile samples and transmittal of lab results to CDM and BRC. · Select waste transport service provider. · Select waste disposal facility for BRC approval (through CDM). · Prepare waste manifests for BRC approval. · Prepare final waste disposal documentation.

TBD – To be determined
Note: This table is meant to supplement the Project Team Roles and Responsibilities Table found in Section 12 of the Project Management Plan ((Haley & Aldrich, 2004b).

Section 13

13

Section Thirteen

Section 13
Project Communication

All field staff will conduct operations in a manner that is discrete and non-disruptive. Project staff shall make efforts to keep all testing operations as confined as feasible so as to minimize site impact. In the event that the general public asks questions of field personnel regarding the injection activities, field personnel will refer to the information provided in the pre-field checklist (Appendix A).

Communication with BRC, property owners, and tenants will also occur to minimize the impact of pre-remediation activities on other activities at the site. Project staff will work with BRC, H&A, Sunrider, and other stakeholders to develop good working relationships while onsite. All project staff will work with oversight and management staff to help support good communication between BRC and stakeholders. Project staff will have weekly team teleconferences and will provide daily field team reports as well.

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Section Fourteen

Section 14

Section 14
References

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Haley and Aldrich, Inc. 2002b. *Site-Wide Groundwater Assessment Report,* Boeing Realty Corporation, Former C-6 Facility, dated November 18, 2002.

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Boeing Realty Corporation, 4900 Conant Street, Long Beach, California, dated August 16, 2004.

Haley & Aldrich, Inc. 2004b. *Project Management Plan,* Former Boeing C-6 Site, Los Angeles California, prepared for Boeing Realty Corporation, 4900 Conant Street, Long Beach, California, dated June 23, 2004.

Kennedy Jenks Consultants, Inc. 2000. *Groundwater Status Report, Boeing Realty Corporation, Former C-6 Facility, Los Angeles California,* dated October 27, 2000.

Appendix A

Appendix A
Pre-Field Checklist

(To be completed later)

Appendix B

Appendix B
Standard Operating Procedures and Equipment Cut Sheets

SOP #1 - Hydraulic Injection Setup Procedure

Before any testing is initiated, all pre-field activities detailed in Section 2 will be completed. Project staff will also communicate with BRC to determine acceptable placement of field equipment, water hoses/hose guards and other site disturbances. Project staff will communicate with BRC to determine an acceptable schedule for testing so that personnel can access vaults and can monitor inside the buildings for surface seal leakage without being disruptive of site activities. Project staff shall make efforts to keep all testing operations as confined as feasible without impacting efficiency so as to minimize site impact. Finally, project staff will arrange for the delivery of all field equipment to the site and other logistics, such as arranging for fire hydrant use.

Absolutely no fire hydrants located within the Sunrider property (the block surrounded by Knox St, Harborgate Way, Francisco Street, and Normandie Avenue) will be used for testing, as flow through those hydrants will reportedly trip alarms within Sunrider and at the fire department. Fire hydrants located within the public right-of-way should be attached to their fire pump and alarm system, and should be OK to use. However, field staff will coordinate use of any and all fire hydrants with BRC, property owners, and tenants before use.

The following setup procedures shall be used:

Setup Procedure

1. Check in with BRC or other on-site personnel as needed.

2. Connect quick disconnect fittings to both sides of all Dole valves. There should be Dole valves rated for the following flow rates: 1.0 gpm, 2.0 gpm, 4.0 gpm, and 8.0 gpm.

3. Identify which wells will be tested from each vault, using Table 2. Verify tags in each vault using as built drawings. Verify that all tagged out wells are visually distinguishable from non-tagged out wells, and that all field staff understand which wells are not be used.

4. Verify all flowmeters are calibrated and reading properly.

5. Use Figure 3 to identify the location of the wellhead and the alignment of the bioremediation piping, where visual observations will be made for surface leakage. Identify potential seepage locations, such as joints in concrete slabs above the wellheads where molasses seepages were observed previously (Arcadis, 2004a).

6. Verify that the meter on each fire hydrant is completely closed and locked or tagged out. Connect the backflow preventer to the water meter. Connect the fire hose to the backflow preventer at the nearby fire hydrant. Install hose protection system in traffic as needed and setup other appropriate traffic and safety equipment as specified in the Health and Safety Plan.

7. Connect the fire hose to the manifold.

8. Configure the manifold for initial use. No Dole valves should be connected during the initial fill.

9. Verify that the testing manifold has all appropriate limbs and components in place. Verify that there are no "open ends" on the manifold before turning on flow from the hydrant. Close all open manifold valves.

10. Open the valve at the fire hydrant to energize the line.

11. Inspect the system for leaks. If leaks are found, de-energize the system by closing the hydrant valve and repair the leaks as needed.

12. After the system integrity has been verified, use the valves present in the manifold to purge the line to a nearby storm drain until the water runs clear. One the water is clear, close the valve.

13. Open the manifold valves and initiate testing to the desired wells (see SOP #2).

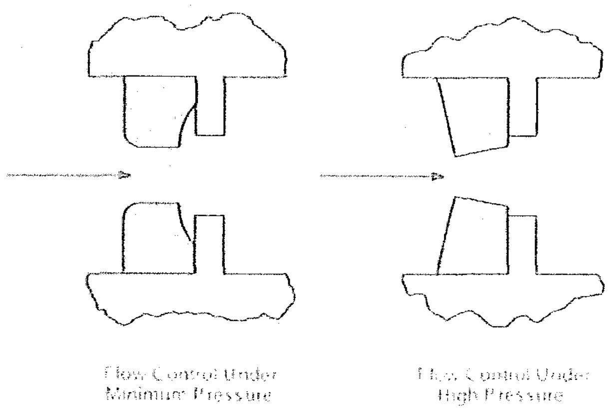
14. Close and open the manifold and/or hydrant valves as needed during testing. Be sure to remove all hose, hose guards and safety equipment at the end of the day.

GE Infrastructure
Water & Process Technologies

Dole Flow Control Valve

Dole Flow Control Valve

The Dole® Flow Regulator is self-cleaning and designed to deliver a constant volume of water flow over a wide pressure drop range. The controlling mechanism is a flexible orifice that varies its effective area inversely with applied pressure so that a constant flow rate is maintained. See Figure 1. Flow rates will be maintained to within ±15% between 15 and 125 psi (1.03 to 8.62 bar). The flow rate varies due to manufacturing tolerances and water temperatures. Valves are chrome or nickle-plated brass with Buna-N orifice. Maximum pressure is 200 psi (13.8 bar). Maximum temperature is 160°F (71°C)



Constant Flow Maintained with Dole Flow Control Valves.

Installation

All Dole valves are marked with an arrow indicating direction of flow. To insure proper operation, always install valves with the arrow pointed downstream. Installations of Dole valves for flow rates < 1 gpm (2.8 Lpm) should include a strainer of 5/64-in. (2 mm) mesh or smaller to prevent plugging.

Specifications

GE Betz Part Number	Model	Flow, gpm (Lpm)	Inlet Connection, in.	Physical Dimensions, in. (cm) Height	Length
1407096	$^{1}/_{2}$ GA	0.5 (1.9)	$^{3}/_{8}$ FNPT	$^{7}/_{8}$ (2.2)	1 $^{3}/_{4}$ (4.4)
1407097	1 GA	1.0 (3.8)	$^{3}/_{8}$ FNPT	$^{7}/_{8}$ (2.2)	1 $^{3}/_{4}$ (4.4)
1407098	2 GB	2.0 (7.7)	$^{1}/_{2}$ FNPT	1 (2.5)	1 $^{15}/_{16}$ (4.9)
1407099	3 GB	3.0 (11.4)	$^{1}/_{2}$ FNPT	1 (2.5)	1 $^{15}/_{16}$ (4.9)
1408031	5 GC	5.0 (19.0)	$^{3}/_{4}$ FNPT	1 $^{1}/_{4}$ (3.2)	2 $^{9}/_{32}$ (5.8)
2031644	5 GX	5.0 (19.0)	1 FNPT	1 $^{1}/_{2}$ (3.8)	2 $^{3}/_{4}$ (7.0)
2031206	8 GX	8.0 (30.3)	1 FNPT	1 $^{1}/_{2}$ (3.8)	2 $^{3}/_{4}$ (7.0)
1497381	10 GX	10.0 (38.0)	1 FNPT	1 $^{1}/_{2}$ (3.8)	2 $^{3}/_{4}$ (7.0)
2031643	12 GX	12.0 (45.4)	1 FNPT	1 $^{1}/_{2}$ (3.8)	2 $^{3}/_{4}$ (7.0)

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SOP #2 - Hydraulic Injection Test Procedure

The following testing procedures shall be used. For efficiency, it is recommended that field staff stagger the testing of wells so that one well is receiving the initial fill while another well is receiving the step testing and another well is receiving the duration testing. This practice is intended to maximize the amount of concurrent testing that can occur, as the initial fill and the duration test do not require the same amount of attention from field staff as step-testing does. Project staff shall make efforts to keep all testing operations as confined as feasible without impacting efficiency so as to minimize site impact.

<u>Test Procedure</u>

1. At all stages of the test, perform the following:

    a. **During all steps, perform visual observations for surface leakage. If any is observed, discontinue the test.** Notify project management personnel. Perform visual inspections above the location of the wellhead for surface leakage and along the orientation of the buried pipe (if possible) for leakage to other areas. Implement contingency plans as needed.

       <u>Important Note:</u> **Additional personnel will be deployed to visually inspect for surface leakage during testing, as areas needing inspection are not visible from the well vaults.**

    b. During the test, continually inspect the manifold and injection lines for leakage. If leakage is found, discontinue flow through that line and implement contingency plans.

    c. Use the information in Table 2 to determine the maximum allowable pressure for the well being testing and the observed flow rate. **If the pressure at the manifold exceeds this maximum pressure, use the manifold to lower the pressure or discontinue testing of that well. The maximum pressure is based on a calculated 1 psig pressure over the static water column head at the well screen. Only wells that are exhibiting vacuum conditions (e.g. siphoning) will be tested.**

2. Fill the well with the initial water volume:

    a. Identify the next well listed on Table 2 to be tested. Do not simultaneously test one well pair (i.e. IRZB34A and IRZB34B). Also, minimize testing of adjacent wells as much as feasible. Minimization of testing of adjacent stub-ups should also be done to maximize efficiency.

    b. Start flow water to the well. Record observations on the data sheet every 5 minutes during the initial fill. No Dole valves should be connected during the initial fill.

c. If the pressure at the manifold exceeds the maximum pressure, use the gate valve on the limb to reduce to pressure in the line. If field staff cannot maintain flow during the initial fill without exceeding the maximum pressure, discontinue the test.

d. Once the volume delivered to the well exceeds 200 gallons, or the length of time elapsed during the initial fill exceeds 1 hour, use the gate valve on the manifold limb to discontinue flow. Move on to Step 3.

3. Perform the step testing:

    a. Quickly disconnect the manifold limb from the manifold. Attach the 1.0 gpm Dole valve, and connect the limb to the valve.

    b. Begin flow to the well. Use the flowmeter to determine the observed flow. Record observations on the data sheet at least every 2 minutes during the step testing. **At no time during the test should field staff exceed the maximum pressure. If field staff cannot maintain flow during the initial fill without exceeding the maximum pressure, discontinue the test.** Field staff should attempt to determine the largest amount of flow that each well can accept without exceeding the maximum pressure.

    c. Continue flow until 10 minutes have passed or until the well has stabilized. The criteria for successful stabilization is no more than a 20% change in pressure over a period six minutes (i.e. at least three readings).

    d. If flow cannot be maintained within 20% of the rated flow rate (i.e. flow is less than 0.8 gpm with the 1.0 gpm valve), move onto Step 4. Allow flow to continue.

    e. If flow can be maintained within 20% of the rated flow rate (i.e. flow is greater than 0.8 gpm with the 1.0 gpm valve), move on to the next step.

    f. Repeat steps 3a through 3e for each of the next larger Dole valves (2 gpm, 4 gpm, and 8 gpm). Move onto Step 4 as appropriate.

4. Perform the duration testing:

    a. Continue flow to the well. Use the flowmeter to measure the flow. Record observations on the data sheet at least every 5 minutes during the duration testing. **At no time during the test should field staff exceed the maximum pressure. If field staff cannot maintain flow during the initial fill without exceeding the maximum pressure, discontinue the test.** Field staff should attempt to determine the longest amount of time that each well can accept flow without exceeding the maximum pressure.

b. Continue the injection for 30 minutes. Once 30 minutes have passed, discontinue flow to the well and move on to the next well. Use a copy of Table 2 to keep track of which wells have been tested.

SOP #3 - Well Construction and Destruction SOPs

The attached SOPs are adapted from Haley & Aldrich SOPs developed for LOT 8 - Parcel C groundwater remediation well installation program for former C-6 Facility (Haley & Aldrich, 2004). It should be noted only those procedures which are directly applicable to this work plan will be used.

Please note that the Haley & Aldrich water injection SOP has not been included, as new SOPs for water injection was developed and included above (SOP#1 and #2).

WELL CONSTRUCTION AND DESTRUCTION STANDARD OPERATING PROCEDURES FOR LOT 8 – PARCEL C GROUNDWATER REMEDIATION WELL INSTALLATION PROGRAM FORMER BOEING C-6 FACILITY LOS ANGELES, CALIFORNIA

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1. INTRODUCTION

The purpose of this document is to present the standard operating procedures (SOPs) required for installing and constructing 166 amendment wells (AWs) and seven groundwater monitoring wells (MWs) in Parcel C of the former Boeing C-6 facility (Site) in Los Angeles, California. The wells are to be installed as part of the groundwater remediation program for the Site. This document also presents the procedures to be used if an AW or MW has to be destroyed.

The AWs and MWs will be installed into the B-Sand or the C-Sand in five phases of work, described below:

- Phase I – 18 geologic reconnaissance AWs will be drilled at selected locations in Lot 8 and Parcel A of the Site;
- Phase II – 17 AWs will be installed in Parcel A of the Site;
- Phase III – 40 AWs will be installed in the graded pad of the future building planned for Lot 8.
- Phase IV – 81 AWs will be installed in Lot 8 in areas outside the area of the building pad.
- Phase V – seven MWs will be installed in Lot 8 and Parcel A following development of the Site.

This well installation SOP addresses the following items:

- Pre-drilling activities
- AW and MW well design
- Well installation procedures
- Well destruction procedures

2. PRE-DRILLING ACTIVITIES

The pre-drilling activities addressed in this section include: permits, well location selection and marking, utility clearance, equipment assembly, field documentation, and construction methods documentation.

2.1 Well Permits

Los Angeles County Department of Health Services (LACDHS) requires permits for the injection and monitoring wells. These permits must be obtained for all wells installed at the Site. Upon receipt of the Well Installation Permits, LACDHS requires at least 48-hours notification prior to well installation. Installation of the AWs and MWs should not proceed until approval (written or verbal) has been obtained from the LACDHS.

2.2 Pre-field Documentation and Checklists

The following documents and checklists will be prepared and maintained on-Site during the field activities:

- Site-specific Health and Safety Plan;
- Pre-field Checklist;
- Incident reporting Procedures; and
- Standard Operations Checklist and Dash Card.

2.3 Project Team Kick-off Meetings

Prior to the initial mobilization to the field, a project team kick-off meeting will be held to review the scope of work and the Well Installation Implementation Plan. Attendees to this pre-field kick-off meeting will include Haley and Aldrich's Project Manager and Task Leader, the driller's Project Manager, and the Boeing Project Manager. The kick-off meeting will also discuss and clarify the rolls and responsibilities of project team members during the well installation program, and discuss the schedule of events during the field program. If any changes to the scope or SOPs to be used during the well installation program are identified during the pre-field kick-off meeting, the Implementation Plan and appropriate SOPs will be revised.

One the first day of field work for each of the five phases of the well installation program, a field kick-off meeting will be conducted at the Site. Attendees will include at a minimum Haley and Aldrich's Task Manager, Field Coordinator/Supervising Geologist, Health and Safety Coordinator, and the Oversight Geologist(s), the driller's Task Leader, and the Boeing Project Manager.

2.4 Well Locations and Marking

The locations of the proposed AWs and MWs are shown on Figure 2 of the Implementation Plan. The locations of the AWs and MWs are based on the California Regional Water Quality control Board – Los Angeles Region (LARWQCB) approved locations presented in the work plan for the groundwater remediation pilot study (Arcadis, 2002). The installation phase and well construction details of each well to be installed are presented in Table II of the Implementation Plan. Prior to each phase of the well installation activities, a surveying subcontractor will survey the locations of each of the AWs or MWs to be installed during that phase of work. Locations are to be marked with wood stakes and flagging.

2.5 Utility Clearance

After the well boring locations have been marked, each location will be assessed as to the potential presence of subsurface utilities or known obstructions. The task manager or his/her delegate should identify alternate well boring locations in the event that utilities or other subsurface obstructions are present at the pre-selected locations. In addition, Underground Service Alert (USA) will be notified prior to the advancement of any boring on-site (USA requires at least a 3 business-days notice). Because of on-going development, well locations in Parcel A and the southern portion of Lot 8 along Knox Street will also be cleared for subsurface utilities by a geophysical locator subcontractor and hand augered to a depth of 5 ft below ground surface (bgs) prior to drilling. The remaining well locations in Lot 8 do not require hand auger clearance.

The seven proposed monitoring wells will be installed during Phase V of the installation program, following complete development of the Site. To protect newly installed utilities, each MW location will be cleared by the geophysical locator subcontractor, USA, and will also be hand augered to a depth of 10 ft bgs in a triangular pattern surrounding the well location.

2.6 Concrete Cutting

Some well boring locations may require concrete/asphalt cutting to gain access to the underlying soil. If necessary, well locations will typically require a 2-foot by 2-foot area of asphalt or concrete to be removed to provide sufficient space for the installation of a monitoring well or wells and completion of the well box or protective casing.

2.7 Instrument Calibration and Equipment Organization

Prior to drilling, field equipment will be checked for possible malfunctions, cleaned, and calibrated. Instruments to be used during well installation and development include:

- Photo Ionization Detector (PID) for work area air monitoring and headspace analysis of soil cuttings;
- Electronic water level sounder;
- Water quality parameters (e.g., pH, electroconductivity, temperature, turbidity and dissolved oxygen) for monitoring purge water quality during well development; and
- Pressure transducers to monitor groundwater levels during development pumping and injection testing.

Calibration procedures provided by the manufacturers should be followed for each instrument. Calibration verification will be performed in the field prior to initial instrument use, at least once a day, or when any indication of instrument malfunction is observed. Oversight geologists are responsible for documenting the calibration verification readings and associated notes for each day that the instruments are used. This information may be recorded in the field activity logbook or on the approximate field instrument calibration log.

Following the maintenance and calibration of all field instruments, the equipment and materials necessary to support the monitoring well installation task will be assembled.

2.8 Field Documentation

A bound field activity logbook will be maintained to document field activities associated with the installation of AWs and MWs. Well construction and development details will be logged (along with any other comments that will aid in the ability to reconstruct the drilling activities without reliance on memory) on the monitoring well construction diagrams (Appendix A – Field Forms) and the field activities logbook. Entries will be made in waterproof black ink. In the case of an error, corrections will be made by crossing a single line through the incorrect information and entering the correct information. All corrections will be initialed and dated.

The following information will be recorded during well installation:

- Drilling contractor's name;
- Drilling method;

- Date of installation;
- Depth of borehole;
- Name of oversight geologist;
- Well number and location with measurements to nearby landmarks;
- Site name and project number;
- Types of construction material and quantity of material (screen type and length, volumes of filter pack, bentonite chips and cement/bentonite grout, mixture of grout, etc.);
- Methods of placement of filter pack, bentonite seal, and annular Portland cement/bentonite seal;
- Static water level after well installation;
- Total depth of well after installation and description of bottom (i.e., hard, soft, etc.);
- Location and description of survey measuring point on well casing;
- Description of fluids added during installation (composition, source, and volume).

All geologic logs, well construction and well development record forms will be provided to the Boeing Technical Manager every two days for review. Geologic description and well construction details will also be included in an electronic object log and uploaded to the Boeing EDMS. A complete set of all field activity logs and field forms will be transmitted on CD to the Boeing Project Manager upon completion of each phase of work.

3. AMENDMENT WELL AND MONITORING WELL DESIGN

The AWs and MWs have similar designs and installation procedures. The designs for the B-Sand and C-Sand AW and MWs are described in Sections 2.1 and 2.2, respectively. The procedures to be used during installation of the AWs and MWs are described in Section 2.3

3.1 B-Sand Amendment Wells and Monitoring Wells

The typical well diagrams of the B-Sand AWs and MWs are shown on Figures 4 and 5 of the Implementation Plan, respectively. A total of 110 AWs and three MWs will be installed in the B-Sand. The B-Sand water bearing unit AWs and MWs will be constructed to the following design:

- Total depth of approximately 85 ft bgs (Depth to be confirmed through the Phase I geologic reconnaissance program);
- Boring to be drilled using hollow stem auger drill rig with 8-inch outside diameter by 5 ft long augers;
- The well casing will consist of 2-inch diameter, poly vinyl chloride (PVC) well casing and screen;
- The screen of the AWs will consist of approximately 20 ft of screen with 0.020-inch machine cut slots. The screen of the MWs will consist of 15 ft of screen with 0.010-inch machine cut slots.
- The screened interval for the AWs will be placed opposite the VOC-impacted water-bearing sand encountered from approximately 65 ft to 85 ft bgs (70 ft to 85 ft bgs for the MWs). However, the actual depth will be confirmed or refined following evaluation of the geologic reconnaissance AW installation described in Section 2 of the Implementation Plan.
- The filter pack material to be used for the AWs will be No. 3 Monterey sand, or equivalent. The filter pack of the MWs will be No. 2/12 sand, or equivalent. The filter pack material may be altered following review of sieve analysis reports of soil samples collected during the Phase I geologic reconnaissance program.
- The filter pack will be installed from total depth to 1 ft above the top of the screened interval. The method of placement and settlement of the filter pack is described in Section 2.3;
- The bentonite seal is to consist of 5 ft of ¼-inch WYO-BEN pellets placed in 12-inch maximum lifts. A minimum of 2.5 ft of the bentonite chip seal must be installed below the static water table to ensure constant hydration of the seal. The method of placement and hydration of the bentonite seal is

described in Section 2.3;

- The remaining annular seal will consist of a Portland cement grout with approximately 4 percent bentonite powder added by weight. The mixture and procedure for placement of the annular seal is described in Section 2.3.
- The level of the grout seal in each well will be periodically inspected for one week following installation to observe any settling of the grout. If settlement is observed, additional grout will be mixed and added to bring it within 3 ft of grade. Any soil which caves into the borehole will be removed prior to placement of additional grout.
- For AWs installed outside of the pad for the planned building, a minimum of 2 ft of stickup of the well casing will remain above grade. The well will be capped with a PVC slip cap and marked with wooden stakes or steel rebar and flagging. AWs located within the future building pad will be cutoff a minimum of 3 ft bgs, capped and the boring backfilled to grade with sand to protect the wells during future grading activities.
- The surface completion of the MWs will consist of a 12-inch diameter traffic rated well box set in concrete with the top of the box raised approximately ½-inch above the surrounding pavement to promote drainage away from the MW.

3.2 C-Sand Amendment Wells and Monitoring Wells

The typical well diagrams of the C-Sand AWs and MWs are shown on Figures 4 and 5 of the Implementation Plan, respectively. A total of 56 AWs and four MWs will be installed in the C-Sand. The C-Sand water bearing unit AWs and MWs will be constructed to the following design:

- Total depth of approximately 115 ft bgs;
- Boring to be drilled using hollow stem auger drill rig with 8-inch outside diameter by 5 ft long augers;
- The well casing will consist of 2-inch diameter, poly vinyl chloride (PVC) well casing and screen;
- The screen of the AWs will consist of approximately 20 ft of screen with 0.020-inch machine cut slots. The screen of the MWs will consist of 20 ft of screen with 0.010-inch machine cut slots.
- The screened interval will be placed opposite the C-Sand water-bearing sand encountered from approximately 95 ft to 115 ft bgs. However, the actual depth will be confirmed or refined following evaluation of the geologic reconnaissance AW installation described in Section 2 of the Implementation Plan.

- The filter pack material to be used for the AWs will be No. 3 Monterey sand, or equivalent. The filter pack of the MWs will be No. 2/12 sand, or equivalent. The filter pack material may be altered following review of sieve analysis reports of soil samples collected during the Phase I geologic reconnaissance program.
- The filter pack will be installed from total depth to 1 ft above the top of the screened interval. The method of placement and settlement of the filter pack is described in Section 2.3;
- The bentonite seal is to consist of 5 ft of ¼-inch WYO-BEN pellets placed in 12-inch maximum lifts. The method of placement and hydration of the bentonite seal is described in Section 2.3;
- The remaining annular seal will consist of a Portland cement grout with approximately 4 percent bentonite powder added by weight. The grout will extend from the top of the bentonite seal to within 3 ft of current grade for the AWs. For the MWs, the grout will be placed to within 2 ft of current grade. The grout mixture and procedure for placement of the annular seal is described in Section 2.3.
- The level of the grout seal in each well will be periodically inspected for one week following installation to observe any settling of the grout. If settlement is observed, additional grout will be mixed and added to bring it within 3 ft of grade. Any soil which caves into the borehole will be removed prior to placement of additional grout.
- For AWs installed outside of the pad for the planned building, a minimum of 2 ft of stickup of the well casing will remain above grade. The well will be capped with a PVC slip cap and marked with wooden stakes and flagging. AWs located within the future building pad will be cutoff a minimum of 3 ft bgs, capped and the boring backfilled to grade with sand to protect the wells during future grading activities.
- The surface completion of the MWs will consist of a 12-inch diameter traffic rated well box set in concrete from 2 ft bgs to the pavement surface. The top of the box will be raised approximately ½-inch above the surrounding pavement to promote drainage away from the MW.

4. WELL INSTALLATION PROCEDURES

The following procedures are to be used during installation of the AWs and MWs at the Site.

1. Refer to Section 2 of the Implementation Plan for the details regarding the collection of continuous cores from the 18 AWs installed as part of the Phase I geologic reconnaissance program. This information will be used to determine the completion depths, well screen intervals, and filter pack specification for the remaining 148 AWs and seven MWs. The 148 remaining AWs are to be drilled without the collection of soil samples for geologic logging. During drilling of the seven MWs, soil samples will be collected for geologic logging at 5 ft intervals using a split-spoon sampler equipped with a sand catcher device but not internal sample rings.

2. Prior to installation, the PVC casing and screen will be decontaminated (if not pre-wrapped. Decontamination of the materials may also be done by high pressure steam cleaning. All personnel handling the decontaminated well materials should wear clean disposable PVC gloves to ensure that the material does not become contaminated prior to installation.

3. After decontamination of all down-hole drilling equipment, the well boring will advanced to the desired well depth. The lead auger/bit used for reaming the boreholes that are not continuously cored will be fitted with a clean wooden plug to maintain a soil-free annulus during reaming.

4. A weighted tape-measure will be used to verify the depth to the bottom of the boring before and after knocking out the wooden plug. The wooden plug is then knocked out with the drill stem rods and 140-pound hammer.

   Note: In cases where heaving sands are encountered, clean potable water may be added to the borehole through the auger to displace the material during installation. The pressure created will keep the casing from moving upward in the augers. During Phase I and possibly Phase II, potable water will be available at the soil vapor extraction compound. For future phases of work, potable water may be obtained from the fire hydrants in Knox Street under permit with the City of Los Angeles. Under no circumstances shall the fire hydrants on the commercial property located south of Knox Street be used due to their connection to an alarm system.

5. When the appropriate depth has been achieved, PVC well screen and casing will be assembled and lowered through the hollow-stem augers. Unless wrapped with plastic from the manufacturer, the well casing and screen for the MWs will be decontaminated before being placed in the borehole. Decontamination of the well casing and screen for the AWs is not required.

6. Once the screen and casing are in place, the sand pack material is poured slowly through the annulus between the interior of the hollow-stem augers and the well casing. The filter pack material to be used for the AWs will be No. 3 Monterey sand, or equivalent. The filter pack of the MWs will be No. 2/12 sand, or equivalent. The filter pack specifications may be altered based on the results of sieve analyses of soil samples collected during the Phase I geological reconnaissance well installation program. The augers can be withdrawn during the placement of the filter pack sand, but the tip of the augers must remain below the top of the filter pack throughout the process to prevent caving of formation material into the annulus between the borehole and the well screen. Following placement of the filter pack to a level of 1 ft above the top of the screen, the well will be surged for approximately 10 minutes with a vented surge block to settle the filter pack. The level of the filter pack will then be measured and additional filter pack material added, if necessary, to bring the level a minimum of 1 ft above the top of the screen. The well will then be surged for an additional 5 minutes and the filter pack level again measured. This process will continue until no further settlement of the filter pack greater than 0.05 ft is measured.

7. The final depth to the sand pack will be recorded on the monitoring well construction form (Figure 1-1). In addition, the volume of sand used for the gravel pack should be recorded in the field activity logbook.

8. The bentonite seal is to consist of 5 ft layer of ¼-inch WYO-BEN pellets placed in 12-inch maximum lifts. The thickness, hydration, and placement of the bentonite seal are critical to seal-off adjacent water bearing zones. To insure constant hydration of the bentonite pellets in the B-Sand AWs and MWs, a minimum of 2.5 ft of the bentonite seal must be installed below the static water table depth/elevation as verified in adjacent MWs or AWs. The screen interval of the C-Sand wells is sufficiently deep enough to ensure constant hydration of the bentonite seal. Following placement of each bentonite pellet lift, a capped tremie pipe will be used to tamp the pellets in-place and the lift allowed to hydrate for up to 10 minutes before the next lift is placed. Prior to placing the next lift, it will be confirmed that there is a minimum of 2 ft of water above the top of the previous lift. If necessary, additional potable water will be added to the annulus to allow hydration of the next bentonite pellet lift. This placement method will be repeated until the entire 5 ft bentonite seal is placed. As the bentonite seal bentonite seal is placed, the augers can be withdrawn. However, to prevent the formation material from caving around the well screen and casing, at no time shall the base of the augers be allowed to rise above the top of the placed bentonite seal level.

9. The final depth to the bentonite seal and seal thickness will be recorded on the monitoring well construction form. In addition, the volume of bentonite used for the seal should be recorded in the field activity logbook and compared to the calculated volume in the field to verify adequate seal placement.

10. The remaining annular seal will consist of a Portland cement grout with approximately 4 percent bentonite powder added by weight. The mixture will consist of the following; 94 pound bag of Portland Type I/II cement, 4 pounds of bentonite powder, and approximately 8 to 9 gallons of potable water. The bentonite powder and water shall be mixed first and the cement added after it has mixed. The cement and bentonite powder must be loose and free of lumps. The grout will be mixed immediately prior to placement in each individual well. Because of the small annular space between the well casing and the inner wall of the hollow stem auger, a tremie pipe of 1-inch diameter must be used. Because of this small diameter tremie pipe, the grout mixture must have a density between 14.5 and 15.0 pounds per gallon and be fully mixed. The oversight geologist must approve the mix and consistency of each grout mix used using a 1/2-gallon container and a weight scale. The grout will be placed from above the bentonite seal to within 3.5 ft of ground surface using a temporary tremie pipe with the bottom of the pipe placed within 2 ft of the bentonite seal. Grout shall be tremied into the auger annular space as the augers are withdrawn. A minimum of 2 ft of grout shall be maintained in the base of the augers at all times as they are withdrawn. The tremie pipe can be withdrawn during the grouting process, but the tip of the pipe and augers must remain below the top of the grout throughout the process. The well will be periodically inspected in the days following placement of the grout seal to ensure that no settlement occurs and additional grout added to maintain the level approximately 3.5 feet bgs. Any soil or other debris observed on top of the grout seal will be removed prior to adding additional grout, if necessary.

11. For AWs installed outside of the pad for the planned building, a minimum of 2 ft of stickup of the well casing will remain above grade. The well will be capped with a PVC slip cap and marked with wooden stakes and flagging. AWs located within the future building pad will be cutoff a minimum of 3 ft bgs, capped and the boring backfilled to grade with sand to protect the wells during future grading activities.

12. The surface completion of the seven monitoring wells will be a 12-inch diameter traffic rated well box set in concrete. The top level of the well box will be raised approximately ½-inch above the pavement level to promote drainage away from the box.

13. Record the applicable geologic and well construction data in the electronic object log and upload the log to the Boeing EDMS.

5. WELL DESTRUCTION PROCEDURES

The purpose of this section is to present the procedures required for the destruction of an AW if well development or water injection testing (WIT) (See Appendix D of the Implementation Plan) indicates that the AW does not have good hydraulic connection to the target water bearing unit (i.e., B-Sand or C-Sand) and can not be used for the addition of amendment.

5.1 Destruction Activities

The well destruction activities addressed in this section include: permits, review of existing well information, equipment assembly, field documentation, and well destruction methods.

5.1.1 Required Permits

LACDHS requires permits for well destruction. LACDHS well destruction permits will require at least 7 working days for the approval process. Well destruction should not proceed until written or verbal approval has been obtained from the LACDHS.

5.1.2 Preliminary Well Review

Prior to initiating the well destruction activities, the Field Coordinator/Supervising Geologist or Task Manager will review all relative information regarding the details of construction and the relative soil and groundwater data associated with the well to be destroyed. The site geologist will inspect the well location for access or obstructions such as equipment storage or materials placement on top of or near the well cover.

5.1.3 Concrete Cutting

Prior to well destruction, the concrete and asphalt surrounding the existing well (if present) will be cut and removed. Enough concrete should be removed to provide sufficient space for the well destruction procedure.

5.1.4 Instrument Calibration and Equipment Organization

Prior to drilling, field equipment will be checked for possible malfunctions and calibrated according to procedures provided by the manufacturer. Field instrument calibration verification will be performed in the field prior to their initial use at least once a day, or when any indication of instrument malfunction is observed. This information may be recorded in the field activity logbook or on the appropriate field meter calibration log.

Following the maintenance and calibration of all field instruments, the equipment and materials necessary to support the well destruction task will be assembled.

5.2 Field Documentation

A field activities log book will be maintained for all field activities associated with the destruction of a well. Entries will be made in waterproof black ink. In the case of an error, corrections will be made by crossing a single line through the incorrect information and entering the correct information. All corrections will be initialed and dated.

The following information will be recorded for each well destroyed:

- Drilling contractor
- Name of field person(s)
- Well number and location
- Well depth and static water level
- Well destruction equipment and method employed
- Date and time of well destruction
- Type and volume of sealant material (volume should be consistent with the anticipated borehole volume)

5.3 Well Destruction Methods

Wells will be destroyed by over-drilling and removal using a hollow-stem auger drilling methods, or LACDHS and Boeing Project Team approved alternate drilling/destruction methods.

The procedures for destroying a well are as follows:

1. Once the surrounding asphalt and concrete (if present) has been removed, the existing well cover and well box (if present) can be removed.

2. Set up the drill rig over the well to be destoyed. With a hollow-stem auger (10-inch minimum diameter), over-drill the existing cement/bentonite seal and sand pack along the entire length of the well.

3. Advance the auger drill string to the desired removal depth (total depth). With the hollow-stem in place, pull the existing well casing through the open augers using the wire-line winch attached to the drill rig. Containerize the well waste materials as described Section 1.4 of this exhibit.

4. Prepare the bentonite-cement grout (sealing material) using the following mixture:

- One 94-pound sack of Portland Type I/II cement
- Approximately 3 to 5 pounds of powdered bentonite
- 6.5 gallons of clean potable water
- The density of the grout mixture should range from 15.6 to 16.2 pounds per gallon and must be verified by the oversight geologist using a calibrated container and weight scale.

NOTE: An alternate approved mixture may be used in place of the bentonite-cement grout mixture above if the alternate mixture complies with the California water well standards.

5. Backfill the vacated boring annulus with a bentonite-cement grout by tremie pipe methods, to prevent the grout from free-falling or becoming diluted or separated during installation. Retract the hollow-stem augers from the borehole at the same rate that the grout is being pumped to prevent the borehole from caving in prior to placement of the sealing material. The grout should be added to the borehole at a speed that will keep the groundwater from rising to the surface and flooding the area around the borehole.

   NOTE: The volume of grout used to seal the borehole should be greater than the calculated volume of the total depth of the borehole.

6. Fill the remaining borehole annulus to approximately 1 ft below the ground or pavement surface with the grout mixture. Record the volume of grout used to seal the borehole.

7. Decontaminate all drilling equipment using a high pressure washer and steam cleaner, or by hand washing with and Alconox solution and two tap water rinses.

8. Contain all soil cuttings, solid wastes, and any displaced groundwater in 55-gallon drums. Seal each drum with a drum lid. Label drums according to the Waste Handling section (Section 3.3) in the Implementation Plan.

9. Place all trash (i.e., spent gloves, paper towels, plastic sheeting, etc.) in plastic garbage bags and dispose of properly.

WELL DEVELOPMENT AND WATER INJECTION TESTING STANDARD OPERATING PROCEDURES FOR LOT 8 – PARCEL C GROUNDWATER REMEDIATION WELL INSTALLATION PROGRAM FORMER BOEING C-6 FACILITY LOS ANGELES, CALIFORNIA

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1. INTRODUCTION

The purpose of this document is to present the standard operating procedures (SOPs) required for development of the 166 bioremediation amendment wells (AW) and seven groundwater monitoring wells (MWs) in Lot 8 – Parcel C of the former Boeing C-6 facility (Site) in Los Angeles, California. The wells are to be installed as part of the groundwater remediation program for the Site. This document also presents the SOPs to be used for water injection testing if an AW displays low recharge during well development. The development and water injection testing will be overseen by a geologist who will be responsible for ensuring that these standard operating procedures (SOP) are followed.

1.1 Objectives

All newly installed AWs and MWs will be developed prior to use but after the surface seals have been allowed to set for a minimum of 72 hours following well completion. The purposes of well development are to;

- Remove fine-grained formation material from the well which may have entered the well screen during installation;
- Clear fine-grained sediment from the well screen openings to increase hydraulic communication with the filter pack;
- Wash fine grain sediment from the filter pack and increase hydraulic communication with the formation of the water bearing unit; and
- Restore the groundwater properties disturbed during the well installation process.

Removal of fines from the AWs is particularly important, as any fine-grained formation materials could be forced into the formation during amendment injection activities and could inhibit flow and reduce well efficiency.

If any AW displays slow recharge rates during development, a water injection test (WIT) will be performed. The primary purpose of this test is to evaluate the competency of the AW for use as an amendment well. The WIT will also provide hydraulic data that will be used to better plan injection activities.

2. WELL DEVELOPMENT SOP

Development of wells consists of initial development (pre-development) during construction of the well, to settle the filter pack, and development of the well a minimum of 72 hours following placement of the surface seal to wash the well screen and increase hydraulic communication with the formation of the water bearing units. The SOPs for these tasks are described below.

2.1 Pre-Development

Initial development of the AWs and MWs (pre-development) will be performed during emplacement of the well filter pack to ensure that the filter pack has settled. This pre-development procedure is covered in the Well Construction and Destruction SOP (Appendix C, Section 4), but is included here for completeness and cross-reference. Once the well screen and casing are in place, the filter pack material is poured slowly through the annulus between the interior of the hollow-stem augers and the well casing. The filter pack material to be used for the AWs will be No. 3 Monterey sand, or equivalent. The filter pack of the MWs will be No. 2/12 sand, or equivalent. The augers can be withdrawn during the placement of the filter pack sand, but the tip of the augers must remain below the top of the filter pack throughout the process to prevent caving of formation material into the annulus between the borehole and the well screen. Following placement of the filter pack to a level of 1 ft above the top of the screen, the well will be surged for approximately 10 minutes with a vented surge block to settle the filter pack. The level of the filter pack will then be measured and additional filter pack material added, if necessary, to bring the level a minimum of 1 ft above the top of the screen. The well will then be surged for an additional 5 minutes and the filter pack level again measured. This process will continue until no further settlement of the filter pack greater than 0.05 ft is measured.

2.2 Well Development

This section presents the equipment and procedures to be used during well development.

2.2.1 Equipment

The equipment to be used during well development includes the following:

- Well development rig equipped with boom, winch, submersible pump, electric generator, and high pressure washer and steam cleaner;
- 2-inch diameter vented rubber surge block;
- 1.5-inch diameter steel bailer;
- 2-inch diameter submersible electric pump (e.g., Grunfos Redi-Flo 2) with electric cable, steel retaining cable, and Nalgene or Teflon discharge hose;
- Calibrated container and stop watch to measure pump discharge rate;
- 1-liter Imhoff Cone;
- Electronic water level sounder with 0.01 ft increments;
- Level pressure transducer connected to surface data logger with data cable;
- Water quality meters for monitoring pH, electroconductivity, turbidity, temperature, and dissolved oxygen

- Water Development Record form (included in Appendix A of the Implementation Plan)

2.2.2 Well Development Procedures

Prior to development, total depth, the feel of the bottom of the well (i.e., soft or hard bottom), and the static water level in the well will be measured and recorded in the Well Development Record form. A copy of the Well Development Record form is included in Appendix A – Field Forms of the Implementation Plan.

The volume of water contained in the well casing (casing volume) will be calculated using the well diameter, total depth, and the static depth of water measured prior to the start of development activities. The casing column conversion factor for 2-inch inside diameter (ID) schedule 40 Poly vinyl chloride (PVC) well casing is 0.175 gallons per linear foot of casing. Well development will then proceed following the steps below.

1) Wells will first be bailed of any accumulated sediment in the bottom of the well using a steel bailer to remove as much sediment as possible. The bailing time duration, total depth of the well, and volume of water and sediment removed at the end of bailing will be estimated and noted on the Well Development Record.
2) Wells will then be surged using a 2-inch diameter, vented rubber surge block for a period of no less than 1 minute for every linear foot of well screen (a minimum of 20 minutes for a 20 ft length of well screen) to wash water in and out of the well screen through the slotted openings. The surge time duration and total depth of the well will again be measured and recorded on the Well Development Record.
3) The well will again be bailed of any accumulated sediment. The suspended sediment load should be monitored during bailing using a 1-liter Imhoff Cone. Bailing of sediment should be performed until the sediment load decreases to a point that a submersible pump can be used. This point is typically when less than ½- to 1-inch of sediment settles in the bottom of a 1-liter Imhoff Cone. The bailing duration, well total depth, and the volume of water and sediment bailed from the well should again be measured and recorded in the Well Development Record.
4) An electric submersible pump and a water level pressure transducer with data wire leading to the surface will then be inserted into the well and lowered to the pumping depth approximately 2 ft above the base of the well. The transducer's data wire will be connected to a laptop computer for monitoring the water levels during the pumping phase of development. The pre-pumping water level will be measured with an electronic sounder and level transducer activated with water level data recorded every 30 seconds. The simultaneous measurement of the sounder's depth to water level and the transducer's level (height of water column above transducer) reading should be recorded together on the Well Development Record.
5) The submersible pump should be started and adjusted to an initial pumping rate of approximately 2 gallons per minute (gpm). The well should be pumped at 2 gpm for a minimum of 10 minutes to remove suspended sediment. The water level in the well should be monitored with the level transducer data. Every 5 minutes during pumping,

the sediment loading in the discharge water should be monitored with Imhoff Cone and the water quality parameters (i.e., pH, temperature, electroconductivity, turbidity, and dissolved oxygen) monitored with field instruments and recorded in the Well Development Record. The volume of water pumped and the stabilization of the water level at the end of the initial pumping at 2 gpm should also be recorded.

6) If after 10 minutes of pumping at 2 gpm the sediment load in the discharge water remains high (i.e., greater than the sediment loading goal of ¼- to ½-inch of sediment in the base of the Imhoff Cone), the 2 gpm pumping rate should be maintained until the sediment load decreases to less than ¼- to ½-inch in the Imhoff Cone). After the sediment loading goal is reached at the 2 gpm rate, the pumping rate should be increased to approximately 5 gpm for a period of 10 minutes, and the above described monitoring performed.

7) After 10 minutes or if the sediment loading goal is reached (which ever is longer), the discharge rate should be increase to the maximum pumping rate of the pump and the well pumped at this rate until the sediment loading goal is reached. Given the depth of the wells to be developed, 8 gpm is probably the maximum pumping rate possible with the development pump.

8) If the water level in the well drops to the pump intake during pumping, the pumping rate should be decreased until a sustained pumping rate is achieved. The well should be pumped at this sustained rate until the sediment loading goal and the water quality parameters stabilize to within 10 percent of previous readings.

9) If the sediment loading does not decrease to less than ¼- to ½-inch of sediment in the Imhoff Cone within 2 hours of total pumping time, the pump and level transducer should be removed and the well surged for 10 minutes and bailed again to wash fine-grained sediment from the well screen and filter pack, and the pumping process resumed. If the sediment loading goal is not reached with 1 hour of this second pumping phase, the pump should be turned off, but remain in the well with the transducer, and the water level recovery monitored with the level transducer until 80 percent of the static water level is recorded, or 30-minutes, which ever is less. The 80 percent recovery is defined as 80 percent of the distance between the initial static water level and the pumping level measured at the end of the pumping stage. Following this recovery stage, the pump and level transducer can then be removed from the well. The development results should then be evaluated by the Project Team to assess if further development is required or if the well should be identified as unacceptable. If filter pack material is observed in the bailed sediment, video camera logging of the well may be performed to assess the source of the filter pack (e.g., cracked well screen).

10) Once the pump and level transducer are removed from the well, the total depth of the well should be measured and the conditions in the bottom (i.e., hard or soft bottom) of the well recorded in the Well Development Record. This measurement shall be repeated the following day to allow any sediment to settle to the base of the well. If sediment is detected in the base of the well following pump removal or the following day, the well may have to be bailed (with a clean bailer) to remove this sediment.

This sediment may have been washed from the well screen but did not enter the pump intake during the pumping stage and settled in the base of the well.

11) If the sediment loading goal is reached within the 3 hours of total pumping time, the pump should be turned off and the water level recovery monitored as described above until 80 percent of the static level is achieved, or ½-hour of recovery time is measured. The time to achieve 80 percent (or more) recovery should be noted in the Well Development Record.

12) The level transducer data should be saved on the computer with a filename with the AW identification number and date (e.g., filename "AW0022C Devdata 082704.xls") for download and possible further analysis.

13) For MWs, once the sediment loading goal is achieved and the water quality parameters stabilize to within 10 percent of previous readings, development of the MW is considered complete.

14) If an AW takes longer than ½-hour to achieve 80 percent of static water level recovery, the AW should be flagged as a "Slow Recharge Well" and a Water Injection Test (WIT) performed following the WIT SOPs presented in the following section.

15) Following well development, all used equipment (i.e., surge block, bailer, winch cable, pump, electronic sounder, level transducer and data cable, and the water quality meters) should be decontaminated between each well by use of a high pressure washer and steam cleaner, or hand washing with an Alconox solution and a double tap water rinse followed with a distilled water final rinse.

2.2.3 Waste Management

Storage and disposal of the investigation derived wastes (IDW) generated during the well development program will be coordinated with the Boeing Waste Management Specialist Ms. Marcia Taleff a minimum of 2-weeks prior to mobilization for each phase of the program.

Where possible, bailed sediment will be separated from well development water and placed in roll-off bins to be located in a designated waste handling area on the Site. The driller will transport the separated sediment from the well location to the roll-off bins using a soil hopper and a forklift.

Well development water and decontamination rinse water will be placed in a 6,000 gallon holding tank located in a designated waste handling area on the Site. The driller will be responsible for pumping all decon rinse water and well development water into the holding tank.

All debris and trash will be collected and disposed of daily by the driller.

All IDW containers will be labeled with an adhesive waterproof label and waterproof marker and catalogued on a daily basis. Each container label will contain the following information:

- Client (generator) identification (name and address);

- Name and phone number of Boeing Waste Management Specialist;
- Date(s) generated;
- Container Contents (example: well cuttings from well AW-112, development purge water from wells AW-97 and AW-98, etc);
- Estimated volume or capacity; and
- Physical state of material (solid or liquid)

The Field Coordinator will be responsible for maintaining a compiled list of all of the IDW containers generated on a daily basis. A waste inventory form is included in Appendix A. This list is to be provided to the Boeing Waste Management Specialist every Friday during the drilling program.

SOP #4 - Sample Identification

This SOP is meant to be used as a quick reference for proper naming convention for samples collected at the site. All analytical sampling activities shall conform to the Data Management Plan (CH2M Hill, 2002), except samples collected for treatability analysis.

Soil Samples

An example Sample ID would be: EW0004_SS*065*_0001,

for the primary soil sample from EW0004, taken at *065'* bgs.

Groundwater Samples

An example Sample ID would be: EW0004_WG*DDMMYY*_0001,

for the primary groundwater sample collected on the date *MM/DD/YYYY*.

Investigation-Derived Waste (IDW)

An example Sample ID would be: EW0004_*XXDDMMYY*_0001,

for the sample of IDW from EW0004, collected on the date *MM/DD/YYYY*, where *XX* would be one of the following:

- SD Soil Cuttings
- WA Drill Cuttings Aqueous Matrix
- WD Well Development Water
- WG Aquifer Testing Water or other miscellaneous groundwater sources

More complete information can be found in the Data Management Plan.

Appendix C

Appendix C
Template Field Forms

C6 Pre-remediation Hydraulic Injection Testing Data Sheet

Well being tested ______________________________

Date ______________________________ Project Staff Name ______________________________

Time	Dole Valve Installed	Flow Rate	Flow Total	Pressure at Manifold	Maximum Pressure	Testing Phase in progress			Observation, Visual Indications, Comments			
	(gpm)	(gpm)	(gal)	(psig)	(psig)	(initial fill / step / duration)						

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FIELD INVESTIGATION DAILY REPORT

Sheet ______ of ______

Project ______ Project No. ______

Location ______ Date ______

Equipment Rental ______ Company ______ To ______

Equipment Hours ______ F.E. Time from: ______ to: ______ By ______

Visitors:

Attachments ☐ Continued

Distribution Initial

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forms\field\field investigation daily report.p65

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Appendix D

Appendix D

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Appendix D
Incident Reporting Procedures

MINOR INCIDENT REPORTING PROCEDURES

When a minor incident occurs, the first priority is to safely assess the situation, shut down operating equipment/system (if required and still operating), contact personnel listed below in the table, and prevent an uncontrolled release outside to the environment or local stormwater conveyance. **The following steps will be taken after a minor incident is under control:**

1. If the incident involves a release of IDW, electron donor, or other chemicals, immediately call the Storm Water Hotline at 1.800.974.9794 and County ER at 1.323.890.4317. When communicating with the departments, state the following information:

   - Date and Time: The date and time the incident occurred.
   - Location: Where the incident occurred
   - Description: A brief description of the incident and what risks it poses to people, property, and the environment.

2. Record the sequence of events, including probable cause, people who responded to the incident, the extents of the incident, and relevant dates and times. Corrective action will be taken to prevent/repair the cause of the incident, spills will be cleaned up, and operation will be resumed.

3. Contact the following people by both e-mail and phone / voice mail. Field staff should contact Ravi Subramanian or Greg Gibbs (JHA Implementation Manager) first.

Name	E-mail Address	Phone
Robert Scott	Robert.p.scott2@boeing.com	Cell: (818) 620-2527 Work: (562) 733-2229
John Scott	john.r.scott@boeing.com	Cell: (818) 519-9884
Dennis Carlson	dennis.carlson@boeing.com	Cell: (818) 535-7438
Joe Weidmann	jweidmann@haleyaldrich.com	Cell: (805) 451-2320 Work: (805) 563-2426
Mario Stavale	Salvatore.m.stavale@boeing.com	Cell: (562) 824-1827 Work: (562) 733-2173
Ravi Subramanian	subramanianr@cdm.com	Cell: (714) 308-2945 Work: (949) 930-2934
Greg Gibbs	ggibbs@jacobandhefner.com	Cell: (714) 719-6856 Work: (949) 453-1045

When leaving messages and sending e-mails, state the following information:

- Date and Time: The date and time the incident occurred.
- Location: Where the incident occurred.
- Description: A brief description of the incident and what risks it poses to people, property, and the environment.

4. An e-mail containing the following information will be sent to Boeing for review and then forwarded to the Storm Water Hotline and County ER:

    - Background and General Facility Description: Briefly describe the site and the activities occurring at the time of the spill.

    - Failure Analysis: Describe the root-cause of the incident. Describe the chain of events that led to the incident.

    - Corrective Actions Taken: Describe what corrective actions have been taken as of the date of the report.

    - Corrective Action in Process: Describe what additional measures are in process or are being contemplated to minimize the possibility of recurrence.

    - Figures: Include figures and drawings, as necessary, to convey information.

    - Appendices: Append relevant information as necessary.

Additional follow-up actions or responses will be performed at the request of the departments.

MAJOR INCIDENT REPORTING PROCEDURES

When a major incident or emergency occurs, the immediate priorities are to safely get it under control, shut down any operating equipment/systems (if required and still operating), contact the 911 Emergency Services, and prevent an uncontrolled release outside to the environment or local stormwater conveyance if feasible. **The followings steps will be taken after a major incident or emergency is under control:**

1. If the incident involves a fire or a threat to human life and health, immediately contact LAFD emergency response at 911. If the incident involves a release of IDW, electron donor, or other chemicals, immediately call the Storm Water Hotline at 1.800.974.9794 and County ER at 1.323.890.4317. When communicating with the departments, state the following information:

    - Date and Time: The date and time the incident occurred.

    - Location: Where the incident occurred

    - Description: A brief description of the incident and what risks it poses to people, property, and the environment.

2. Record the sequence of events, including probable cause, people who responded to the incident, the extents of the incident, and relevant dates and times.

3. Contact the following people by both e-mail and phone / voice mail. Field staff should contact Ravi Subramanian or Greg Gibbs (JHA Implementation Manager) first.

Name	E-mail Address	Phone
Robert Scott	Robert.p.scott2@boeing.com	Cell: (818) 620-2527 Work: (562) 733-2229
John Scott	john.r.scott@boeing.com	Cell: (818) 519-9884
Dennis Carlson	dennis.carlson@boeing.com	Cell: (818) 535-7438
Joe Weidmann	jweidmann@haleyaldrich.com	Cell: (805) 451-2320 Work: (805) 563-2426
Mario Stavale	Salvatore.m.stavale@boeing.com	Cell: (562) 824-1827 Work: (562) 733-2173
Ravi Subramanian	subramanianr@cdm.com	Cell: (714) 308-2945 Work: (949) 930-2934
Greg Gibbs	ggibbs@jacobandhefner.com	Cell: (714) 719-6856 Work: (949) 453-1045

When leaving messages and sending e-mails, state the following information:

- Date and Time: The date and time the incident occurred.
- Location: Where the incident occurred.
- Description: A brief description of the incident and what risks it poses to people, property, and the environment.

4. Prepare an incident report containing the following information:

- Background and General Facility Description: Briefly describe the site and the activities occurring at the time of the spill.
- Failure Analysis: Describe the root-cause of the incident. Describe the chain of events that led to the incident.
- Corrective Actions Taken: Describe what corrective actions have been taken as of the date of the report.
- Corrective Action in Process: Describe what additional measures are in process or are being contemplated to minimize the possibility of recurrence.
- Figures: Include figures and drawings, as necessary, to convey information.
- Appendices: Append relevant information as necessary.

The incident report will be submitted to Boeing for review. System operations will not be resumed (if applicable) until approval to continue has been granted by Boeing.

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